(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 684 356 A1**

(12) **EUROPEAN PATENT APPLICATION published in accordance with Art. 158(3) EPC**

(21) Application number: **95902294.8**

(51) Int. Cl.[6]: **E05B 65/20**

(22) Date of filing: **01.12.94**

(86) International application number:
PCT/JP94/02030

(87) International publication number:
WO 95/16093 (15.06.95 95/25)

(30) Priority: **10.12.93 JP 310459/93**
20.09.94 JP 225319/94

(43) Date of publication of application:
29.11.95 Bulletin 95/48

(84) Designated Contracting States:
DE FR

(71) Applicant: **NIPPONDENSO CO., LTD.**
1-1, Showa-cho
Kariya-city
Aichi-pref., 448 (JP)

(72) Inventor: **KOBAYASHI, Takashi**
Nippondenso Co., Ltd.,
1-1, Showa-cho
Kariya-city,
Aichi-Pref. 448 (JP)
Inventor: **AMANO, Hitoshi**
Nippondenso Co., Ltd.,
1-1, Showa-cho
Kariya-city,
Aichi, Pref. 448 (JP)
Inventor: **TAKEYAMA, Hiroshi**
Nippondenso Co., Ltd.,
1-1, Showa-cho
Kariya-city,
Aichi-Pref. 448 (JP)
Inventor: **NAKAO, Kazuhiro**
Nippondenso Co., Ltd.,
1-1, Showa-cho
Kariya-city,
Aichi-Pref. 448 (JP)

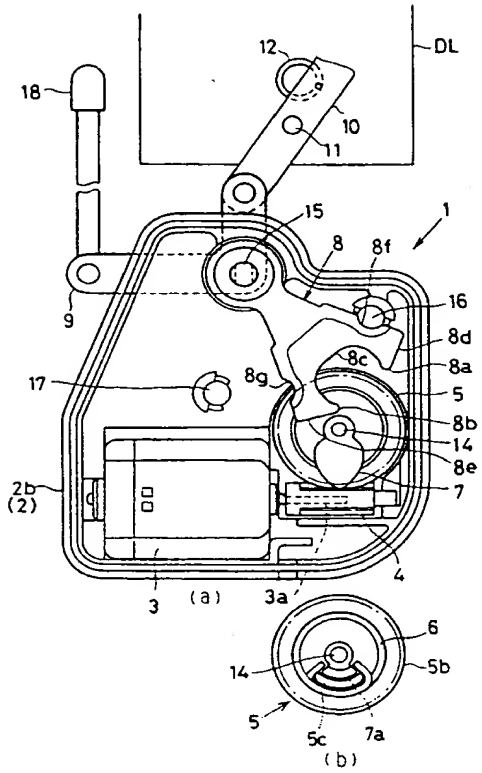
(74) Representative: **Tiedtke, Harro, Dipl.-Ing.**
Patentanwaltsbüro
Tiedtke-Bühling-Kinne & Partner
Bavariaring 4
D-80336 München (DE)

(54) **DOOR LOCK DRIVING DEVICE.**

(57) A cam 7, which is rotated by a motor 3, drives an actuating lever 8 through a torque receiving portions 8a or 8b to move the actuating lever 8 to the door-unlocking position or to the door-locking position and stops when it abuts a stopper walls 8d or 8e which are formed on the actuating lever 8. The intermediate reduction gear 5, which transmits rotating torque through a spring 6, rotates after the cam 7 stops and gradually stops while bending the spring 6. When the motor 3 is deenergized in this state, the intermediate reduction gear 5 is driven in the opposite direction due to elastic energy accumulated in the spring 6. Thus, the cam leaves the stopper walls 8d or 8e of the actuating lever 8 before it stops.

EP 0 684 356 A1

FIG. 1


12
DL
18
10
11
15
1
8
8f
16
9
8d
8c
8a
17
8g
5
8b
14
8e
2b
(2)
7
4
3
(a)
3a
6
14
5b
5
5c
7a
(b)

TECHNICAL FIELD

The present invention relates to a door-lock driving apparatus which locks or unlocks a door of an automobile.

BACK GROUND ART

In a conventional door-lock driving apparatus, an electric motor has a motor shaft, a pinion secured thereto and an intermediate gear which has an engagement projection and is in engagement with the pinion. A resilient member is disposed around a shaft of the intermediate gear and has an end fixed to an output shaft of a driven-lever of a door-lock unit and another end which has a rocking member having an engagement projection rocking between a first position (one stopper) and a second position (another stopper). The engagement projections of the intermediate gear and the rocking member are respectively disposed to engage with or disengage from the resilient member so that the motor torque is transmitted from the intermediate gear through the resilient member to the rocking member. Thus, the door-unlocking may be achieved manually without turning the intermediate gear, thereby providing a noiseless door-lock driving apparatus (Japanese patent unexamined publication Hei 2-49881).

The resilient member of the above described door-lock driving apparatus is made from a coil spring which has two end portions extending in an axial direction disposed at the opposite sides (at an arc angle 180°). One of the portions engages with the engagement projection of the intermediate gear and the other engages with the engagement projection of the rocking member. Since the resilient member is disposed rotatably around the shaft of the intermediate gear, when the motor rotates, the intermediate gear is rotated through the pinion by the motor and the engagement projection of the intermediate gear engages with one of the end portions of the resilient member to bend the resilient member. The other end portion of the resilient member engages with the engagement projection of the rocking member to move until the rocking member abuts the above mentioned stoppers, thereby deenergizing the motor. Thereafter, the intermediate gear rotates in a 180° angle arc under the resilient force of the resilient member which is exerted thereon through the engagement projection of the intermediate gear, and a gear noise is generated at this moment.

The present invention has been made in view of the above circumstances and is to provide a door-lock driving apparatus which reduces the gear noise generated when the motor is deenergized after the door-locking or door-unlocking is completed and the intermediate gear is rotated backward by the resilient member.

DISCLOSURE OF THE INVENTION

In order to achieve the above object, the present invention adopts a door-lock driving apparatus comprising: a motor rotating when energized; a rotating member rotated freely by the motor and a torque transmitting member for transmitting the rotating torque of the rotating member; an actuating member, connected to a door-lock unit carrying out door-locking and door-unlocking, for actuating said door-locking unit when driven by said torque transmitting member to move to a door-locking direction or a door-unlocking direction, said actuating member having a first member to be pushed by the torque transmitting member and a second member formed on an end portion of said actuating member which moves along an arc; a restricting member for restricting motion of said actuating member against rotating torque exerted by said torque transmitting member; and an elastic member disposed between said rotating member and said actuating member; wherein when said motor is energized, said torque transmitting member pushes said first member of said actuating member and drives said actuating member against said restricting member, separates from an arc-shaped motion orbit of said actuating member, subsequently pushes said second member while bending said elastic member to deenergize said motor, and separates again from said arc-shaped motion orbit of said actuating member due to spring force accumulated in said elastic member.

In the door-lock driving apparatus, said actuating member has a first member to be pushed by the torque transmitting member and a second member formed on an end portion of said actuating member which moves along an arc; a restricting member restricts motion of said actuating member against rotating torque exerted by said torque transmitting member; and an elastic member is disposed between said rotating member and said actuating member; therefore, when said motor is energized, said torque transmitting member pushes said first member of said actuating member and drives said actuating member against said restricting member, separates from an arc-shaped motion orbit of said actuating member, subsequently pushes said second member while bending said elastic member to deenergize said motor, and separates again from said arc-shaped motion orbit of said actuating member due to spring force accumulated in said elastic member. As a result, after the door-locking and door-unlocking are carried and the motor is deenergized, the rotating member is slightly rotated due to the spring force, so that

the gear noise, otherwise generated when the rotating member is rotated by the elastic member, may be reduced.

Further, in addition to the above, the present invention adopts the door-lock driving apparatus further comprises a manually operated member connected to said door-lock unit or said actuating member, wherein when said manually operated member is held in a door-locking position, said elastic member bends as it receives rotating torque of said rotating member moving to said actuating member which is retained by said manually operated member and relieves shock applied to said rotating member, and when said motor is deenergized, said torque transmitting member stops after said torque transmitting member separates from said actuating member due to spring force accumulated in said elastic member.

In this embodiment, when the motor is energized with the manually operated member being held in the locking position, said elastic member bends as it receives rotating torque of said rotating member moving to said actuating member which is retained by said manually operated member and relieves shock applied to said rotating member, and when said motor is deenergized, said torque transmitting member stops after said torque transmitting member separates from said actuating member due to spring force accumulated in said elastic member. Thereafter, only small power is necessary to operate the door-lock unit.

In addition to the above structure, the present invention adopts a door-lock driving apparatus, wherein said rotating member comprises a pinion driven by said motor and an intermediate reduction gear; said torque transmitting member is disposed to be rotatable relative to said intermediate reduction gear around a central axis of said intermediate reduction gear; and said elastic member comprises a coil spring held by said intermediate reduction gear at its one end and held by said torque transmitting member at the other end.

In this embodiment, the rotating torque of the motor is transmitted through the pinion to the intermediate reduction gear and through the coil spring as an elastic member to the torque transmitting member. The actuating member is driven by the torque transmitting member to move to the door-locking direction or to the door-unlocking position thereby carrying out the door-locking or door-unlocking.

Since the actuating member having moved to the door-locking or door-unlocking position is restricted by the restricting member, the coil spring having one end held by the intermediate reduction gear and the other end held by the torque transmitting member is rotated by the intermediate reduction gear with the other end being fixed. In other words, the coil spring is bent in the rotating direction of the intermediate reduction gear while accumulating the spring force. Thus, when the motion of the actuating member is restricted, the shock applied through the torque transmitting member and the intermediate reduction gear to the pinion is relieved. As a result, the pinion and the intermediate reduction gear, which are rotating members, may be made of an inexpensive resinous material, thereby providing a cost reduced apparatus.

Further, when the motor is deenergized and the door-lock unit is manually operated via the actuating member, the torque transmitting member is separated from the actuating member due to the spring force accumulated in the coil spring and the operation power is reduced.

In addition to the above structure, the present invention adopts a door-lock driving apparatus, wherein said rotating member comprises a pinion driven by said motor and an intermediate reduction gear; said torque transmitting member is disposed to be rotatable relative to said intermediate reduction gear around a central axis of said intermediate reduction gear; and said elastic member is made of highly polymerized compound such as elastomer or elastic material such as rubber and is disposed between said intermediate reduction gear and said torque transmitting member.

In this embodiment, the rotating torque of the motor is transmitted through the pinion to the intermediate reduction gear and through the elastic member made of highly polymerized compound such as elastomer or elastic material such as rubber to the torque transmitting member. The actuating member is driven by the torque transmitting member to move to the door-locking position or to the door-unlocking position thereby carrying out the door-locking or door-unlocking.

Since the actuating member having moved to the door-locking or door-unlocking position is restricted by the restricting member, the elastic member having one portion being fixed is bent in the rotating direction of the intermediate reduction gear while accumulating the spring force. Thus, when the motion of the actuating member is restricted, the shock applied through the torque transmitting member and the intermediate reduction gear to the pinion is relieved. As a result, the pinion and the intermediate reduction gear may be made of an inexpensive resinous material, thereby providing a cost-reduced apparatus as mentioned above.

In addition to the above structure, the present invention adopts a door-lock driving apparatus, wherein said torque transmitting member comprises an integral elastic member made of highly polymerized compound such as elastomer or elastic material such as rubber.

According to the above structure, the torque transmitting member may be an integral elastic member made of highly polymerized compound such as elastomer or elastic material such as rubber and further reduction of parts may be realized.

The present invention adopts a door-lock driving apparatus comprising: a pinion driven by a motor; an intermediate reduction gear which is in engagement with said pinion and is driven by said pinion; a projection rotating with said intermediate reduction gear; a torque transmitting member having a torque transmitting portion at one end and a portion at the other end which is fixed to said torque transmitting portion and connected to an output member for carrying out door-locking operation; a restricting member for restricting motion of said torque transmitting member against said transmitting torque; and an elastic member, disposed between said projection of said intermediate reduction gear and said torque transmitting portion of said torque transmitting member, for generating driving force to separate said projection from said torque transmitting means by bending.

In this structure, the torque of the intermediate reduction gear is transmitted through the projection and the torque transmitting portion to the torque transmitting member. When the motion of the torque transmitting member is restricted, the elastic member disposed between the projection and the torque transmitting member bends and generates driving force to separate the above two members. As a result, when the motor is deenergized, the shock applied to the pinion and the intermediate reduction gear is relieved, thereby realizing a resinous pinion and a resinous intermediate reduction gear. Since the projection and the torque transmitting member is separated from each other due to driving force generated in the elastic member, the operation power for the door-locking is reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a plan view illustrating an internal structure of a door-lock driving apparatus according to an embodiment of the present invention. Fig. 2 is a cross-sectional side view of the door-lock driving apparatus (first embodiment). Fig. 3 is a graph showing load characteristics of a door-lock unit (first embodiment). Fig. 4 is an explanatory view of the door-lock driving apparatus in operation (first embodiment). Fig. 5 is an explanatory view of the door-lock driving apparatus in operation (first embodiment). Fig. 6 is an explanatory view of the door-lock driving apparatus in operation (first embodiment). Fig. 7 is an explanatory view of the door-lock driving apparatus in operation (first embodiment). Fig. 8 is an explanatory view of the door-lock driving apparatus in operation (first embodiment). Fig. 9 is an explanatory view of the door-lock driving apparatus in operation (first embodiment). Fig. 10 is an explanatory view of the door-lock driving apparatus when a knob is in a lock position (first embodiment). Fig. 11 is an explanatory view of the door-lock driving apparatus when the knob is in the lock possition (first embodiment). Fig. 12 is an explanatory view of the door-lock driving apparatus when the knob is in the lock position (first embodiment). Fig. 13 is an explanatory view of the door-lock driving apparatus when the knob is in the lock position (first embodiment). Fig. 14 is a plan view illustrating an internal structure of a door-lock driving apparatus according to a second embodiment of the present invention. Fig. 15 is cross-sectional and plan views illustrating a intermediate reduction gear, a cam and a resilient member (second embodiment). Fig. 16 is a perspective view illustrating the intermediate reduction gear, the cam and the resilient member (second embodiment). Fig. 17 is a plan view illustrating an internal structure of a door-lock driving apparatus according to a third embodiment of the present invention. Fig. 18 is cross-sectional and plan views illustrating a intermediate reduction gear, a cam and a resilient member (third embodiment). Fig. 19 is a perspective view illustrating the intermediate reduction gear, the cam and the resilient member (third embodiment). Fig. 20 is a plan view illustrating an internal structure of a door-lock driving apparatus according to a fourth embodiment of the present invention. Fig. 21 is a cross-sectional view of the apparatus illustrated in Fig. 20 taken along a line II-II. Fig. 22 is an explanatory view of the door-lock driving apparatus in operation (fourth embodiment). Fig. 23 is an explanatory view of the door-lock driving apparatus in operation (fourth embodiment). Fig. 24 is an explanatory view of the door-lock driving apparatus in operation (fourth embodiment). Fig. 25 is an explanatory view of the door-lock driving apparatus in operation (fourth embodiment). Fig. 26 is an explanatory view of the door-lock driving apparatus in operation (fourth embodiment). Fig. 27 is an explanatory view of the door-lock driving apparatus in operation (fourth embodiment). Fig. 28 is an explanatory view of the door-lock driving apparatus in operation (fourth embodiment). Fig. 29 is an explanatory view of the door-lock driving apparatus in operation (fifth embodiment). Fig. 30 is an explanatory view of the door-lock driving apparatus in operation (sixth embodiment).

BEST MODE OF CARRYING OUT THE INVENTION

A door-lock driving apparatus according to an embodiment of the present invention is described

next with reference to the drawings.

Fig. 1 is a plan view illustrating an internal structure of a door-lock driving apparatus 1. Fig. 2 is a cross-sectional side view of the door-lock driving apparatus 1. In the figures, Fig. 1 (b) and Fig. 4 (b) through Fig. 13 (b) are cross-sectional side views taken along line I - I in Fig. 2.

The door-lock driving apparatus 1 of the embodiment is an actuator which controls a door-lock unit DL for locking or unlocking a door, and is composed of a case 2 having a separate lower case 2a and an upper case 2b, a motor 3 which is rotatable in both direction, a pinion 4 driven by the motor 3, an intermediate reduction gear 5 which is rotatable in mesh with the pinion 4, a coil spring 6 (hereinafter referred to as the spring 6) disposed on the intermediate reduction gear 5, a cam 7 to which the rotating torque of the intermediate reduction gear 5 is transmitted through the spring 6, and an actuating lever 8 driven by the rotating torque of the cam 7. The door-lock unit DL is connected to the door-lock driving apparatus through a rocking lever 10 which carries the door-locking and door-unlocking. The rocking lever 10 rocks between a door-lock position and a door-unlocking position around a pivot 11 disposed on the door-lock unit DL. The door-lock unit DL is biased by a turn-over spring 12 disposed between the unit DL and the rocking lever 10 and drives the door-lock driving apparatus in the direction as shown in Fig. 3 when a load turns over during its operation.

The motor 3 is energized through a terminal 13 (see Fig. 2) which is taken out of the case 2 and changes the rotating direction when the door-locking changes to the door-unlocking and vice versa.

The pinion 4 has a D-cut opening therein and is fitted detachably to a rotary shaft 3a of the motor which has a corresponding D-cut portion so as to rotate together.

The intermediate reduction gear 5 has a boss portion 5a which receives a shaft 14 rotatably that is the center of rotation, gear teeth portion 5b and an arc-shaped engagement wall 5c formed in an axial direction (in parallel with the shaft 14) on the inner periphery of the teeth portion 5b.

The shaft 14 extends in a direction perpendicular to the rotary shaft 3a of the motor 3 and is press-fitted to the lower case 2a at its one end and to the upper case 2b at the other end thereof.

The spring 6 is, as shown in Fig. 1 (b), disposed between the teeth portion 5b and the engagement wall 5c on the inner periphery of the teeth portion 5b of the intermediate reduction gear 5. The both end portions are bent inward (to the center) and hold the engagement wall 5c of the intermediate reduction gear 5 therebetween.

The cam 7, as shown in Fig. 2, is fitted rotatably to the shaft 14 to face the intermediate reduction gear 5 in the axial direction. An arc-shaped engagement wall 7a is formed at a circumferential portion of the shaft 14 on the surface of the cam 7 facing the intermediate reduction gear 5. The engagement wall 7a is disposed between the boss portion 5a and the engagement wall 5c of the intermediate reduction gear 5 in the radial direction of the shaft 14 and has the arc length shorter than the engagement wall 5c of the intermediate reduction gear 5. The cam 7, as shown in Fig. 1 (b), is fitted to the shaft 14 so that the engagement wall 7a is disposed between the both end portions of the spring 6, in other words, disposed at a portion overlapping with the intermediate reduction gear 5 around the shaft 14.

The actuating lever 8 has an output shaft 15 insert-fitted thereto at its one end and rotates around the output shaft 15 between a couple of stoppers (restricting members) 16 and 17.

The output shaft 15 is rotatably supported by the lower case 2a and the upper case 2b.

The actuating lever 8 has torque receiving portions 8a and 8b at a fun-shaped portion radially extending from the output shaft 15. The torque-receiving portions 8a and 8b slide on the cam surface as the cam 7 rotates, thereby to rotate the actuating lever 8 around the output shaft 15 between the door-locking position (the position shown in Fig. 1) and the door-unlocking position (the position shown in Fig. 6 through 9).

The torque-receiving portions 8a receives a rotating torque from the cam 7 when the door-lock unit DL locks the door, and 8b receives a rotating torque from the cam 7 when the door-lock unit DL unlocks the door. A U-shaped recess is formed between the locking-side torque-receiving portion 8a and the unlocking-side torque-receiving portion 8b in order to prevent an interference of the cam 7.

An outer periphery formed continuously between the locking torque-receiving portion 8a and the unlocking torque-receiving portion 8b enters the orbit of the cam motion when the actuating lever 8 rotates to the locking position or to the unlocking position, and functions as stopper walls 8d and 8e to restrict the rotation of the cam 7 when the cam 7 abuts thereon.

The stopper walls 8d and 8e move in an arc around the output shaft 15.

Engagement grooves 8f and 8g are formed on the outer periphery formed continuously between the locking and unlocking torque-receiving portions 8a and 8b of the actuating lever 8 and engage one of the stoppers 16 and 17 when the lever 8 is driven by the cam 7 to rotate to the locking or unlocking position.

The stopper 16 and 17 are disposed at positions symmetrical with respect to an imaginary line between the output shaft 14 and the shaft 15. The

stoppers are made of an elastic material (e.g. rubber) so as to absorb a shock caused when the actuating lever 8 engages therewith.

An output lever 9 is formed into a L-shape and has a hole (not shown) at a bend portion thereof to engage with an insert portion 15a formed at an end portion of the output shaft 15, thereby to rotate as a unit with the output shaft 15 (or actuating lever 8). An end of the output lever 9 is connected to a knob 18 which a driver handles when he intends to operate the door-lock unit DL and the other end is connected to the rocking lever 10 of the door-lock unit DL and the other end is connected to the rocking lever 10 of the door-lock unit DL (see Fig. 1 and Fig. 2).

The operation of the embodiment is described next.

The operation in the door-locking is mainly described here, for convenience.

In the door-locking state shown in Fig. 1, since the actuating lever 8 is in the door-lock position, the door-unlocking-side torque-receiving portion 8b is located in the orbit of the motion of the cam 7.

When the motor 3 is energized in this state, the pinion 4 is driven by the motor and the intermediate reduction gear 5 is rotated by the pinion 4. The driving torque of the intermediate reduction gear 5 is transmitted to the cam 7 through the spring 6 which is held between the engagement wall 5 of the intermediate reduction gear 5 and the engagement wall 7a of the cam 7, and the cam 7 rotates along with the intermediate reduction gear 5 and the spring 6 in the door-unlocking direction (counterclockwise in Fig. 1).

After the cam 7 abuts the door-unlocking-side torque-receiving portion 8b (as shown in Fig. 4), the door-unlocking - side torque-receiving portion 8b slides on the surface of the cam 7 and moves along the cam profile as the cam 7 rotates, and the actuating lever 8 rotates around the output shaft 15 from the door-locking position to the door-unlocking position. The actuating lever 8 does not reach the door-unlocking position (as shown in Fig. 5) when the cam 7 leaves the door-unlocking-side torque-receiving portion 8b, however it continues to rotate thereafter due to the inertia thereof and the load characteristics of the door-locking until the engagement recess 8g abuts the stopper 17.

On the other hand, the cam 7, after leaving the door-unlocking-side torque-receiving portion 8b, rotates until it engages with the stopper wall 8d of the actuating lever 8 (as shown in Fig. 6). Although the cam 7 is stopped by the stopper wall 8d, the intermediate reduction gear 5 further rotates while bending the spring 6 which is held by the engagement wall 5c and stops gradually (as shown in Fig. 7b).

When the motor 3 is deenergized in this state, the intermediate reduction gear 5 rotates in the reverse direction (clockwise in Fig. 1) due to the elastic energy accumulated by the spring 6 (as shown in Fig. 8b). The intermediate reduction gear 5 and the cam 7 continue to rotate to the state shown in Fig. 8 due to its inertia of the motion accumulated in the period from the state shown in Fig. 7 even after the elastic energy dissipates, and stop rotation when the cam 7 leaves the stopper wall 8d (as shown in Fig. 9).

In the apparatus according to the embodiment as described above, the actuating lever 8 has the door-locking-side torque-receiving portion 8b on which the cam 7 abuts and the stopper wall 8d which is formed at the head portion moving in an arc around the shaft 15, the stopper 17 restricts further movement of the actuating lever 8 against the rotating torque exerted by the cam 7, and the coil spring 6 is disposed in the path of the torque transmission. Therefore, when the motor 3 is energized, the cam 7 presses on the door-unlocking-side torque-receiving-portion 8b to move the actuating lever 8 toward the stopper 17 and leaves the generally arc-shaped operation orbit of the actuating lever 8. The cam 7 subsequently presses on the stopper wall 8d while compressing the coil spring 6 thereby to deenergize the motor 3. When the cam 7 leaves the arc-shaped operation orbit of the actuating lever 8 again due to the elastic force of the compressed coil spring 6, the motor 3 is energized again to carry out the door-unlocking. When the motor 3 is deenergized thereafter, the intermediate reduction gear 5 is slightly moved due to the spring force of the spring 6, however, the gear noise is significantly reduced compared with the apparatus in which the intermediate reduction gear 5 is driven mainly by the coil spring 6. The door-locking is also carried out by energizing the motor 3. In this case, the intermediate reduction gear 5 is slightly moved due to the spring force of the coil spring 6 after the motor 3 is deenergized as in the door-unlocking operation, and the gear noise is reduced significantly compared with the apparatus in which the intermediate reduction gear 5 is driven mainly by the coil spring 6.

After the cam 7 abuts the stopper wall 8d of the actuating lever 8 and its further rotation is restricted, the intermediate reduction gear 5 further rotates while bending the coil spring 6 and stops gradually. In other words, the shock caused when the cam 7 abuts the stopper wall 8d is absorbed by bending of the coil spring 6. As a result, the shock, which is applied to the intermediate reduction gear and the pinion 4 when the cam 7 is stopped, is relieved, so that the intermediate reduction gear 5 and the pinion may be made of resinous material, resulting in cost reduction.

When the motor 3 is deenergized, the cam 7 stops after it leaves the stopper wall 8d of the actuating lever 8. Therefore, a driver can handle the knob 8 easily since the actuating lever 8 is not in contact with the cam 7.

The door-locking operation has the same effect as the door-unlocking operation described above.

The operation when the knob 18 is brought to the door-locking position is described next with reference to Fig. 10 through Fig. 13.

When the motor 3 is energized while the knob 18 is held in the lock position, the cam 7 is driven by the motor 3 to rotate along with the intermediate reduction gear 5 in the door-unlocking direction (counterclockwise in Fig. 10) and abuts the door-unlocking-side torque-receiving-portion 8b. The actuating lever 8 receives the driving torque of the cam 7, however it cannot move to the door-unlocking-side because the knob is held in the locking position. Consequently, the cam 7 stops while it is in abutment with the door-unlocking-side torque-receiving-portion 8b of the actuating lever 8 (as shown in Fig. 10).

The intermediate reduction gear 5 further rotates and bends the spring 6 for a while, and stops gradually (as shown in Fig. 11).

When the motor 3 is deenergized in this state, the intermediate reduction gear 5 rotates in the opposite direction (clockwise in Fig. 12) due to the accumulated elastic energy of the spring 6. The intermediate reduction gear 5 further rotates after the elastic energy dissipates due to the motion inertia thereof along with the cam 7 which has been at rest so that the cam 7 leaves the door-unlocking-side torque-receiving-portion 8b and stops (as shown in Fig. 13).

Thus, even when the knob 18 is held in the locking position, the cam 7 abuts the door-unlocking-side torque-receiving-portion 8b and its further rotation is restricted, the intermediate reduction gear 5 further rotates while bending the spring 6 and stops gradually. As a result, the shock given to the intermediate reduction gear 5 and the pinion 4 when the cam 7 is stopped is effectively relieved. When the motor 3 is deenergized, the cam 7 thereafter separates from the door-unlocking-side torque-receiving-portion 8b and stops. Therefore, a driver can handle the knob 18 very easily since the actuating lever 8 does not slide on the cam 7.

A second embodiment of the present invention is described next.

Fig. 14 is a plan view illustrating an internal structure of a door-lock driving apparatus 1.

In the door-lock driving apparatus 1 according to this embodiment, an elastic member 19 made of elastic material such as high-elastic highly polymerized compound (elastomer) or rubber (shown in Fig. 15 and Fig. 16) is used instead of the coil spring 6 which is disposed between the intermediate reduction gear 5 and the cam 7.

Since other members except for the intermediate reduction gear 5, the cam 7 and the elastic member 17 are the same as those of the first embodiment, respective descriptions are omitted.

The descriptions of the intermediate reduction gear 5, the cam 7 and the elastic member 19 are given next with reference to Fig. 15 and Fig. 16.

Fig. 15 is a cross-sectional view (a) and a plan view (b), and Fig. 16 is a perspective view of the gear 5, the cam 7 and the elastic member 19 and an allover perspective view thereof.

The intermediate reduction gear 5 has the same boss portion 5a and teeth portion 5b as the first embodiment has. An engagement surfaces 5d are formed on the inner periphery of the teeth portion 5b to regulate the motion (rotation) of the elastic member 19. The engagement surfaces 5d are formed on two portions respectively corresponding to opposite (normal or reverse) directions of the motor rotation. A recess 5e is formed on a side of the intermediate reduction gear 5 over the entire circumference thereof.

The cam 7 has a disk member 7c formed integrally therewith. The disk member 7c has a given radius from an opening 7b which receives the shaft 14 therein, and a projection bar 7d at an outer portion thereof. The opening 7b of the cam 7 receives the shaft 14 rotatably and the disk member 7c of the cam 7 is fitted to the recess 5e of the intermediate reduction gear 5. A small gap is formed between the outer periphery of the disk member 7c and the inner surface of the recess 5e so that they are not interfere each other (as shown in Fig. 16(d).

The elastic member 19 is fitted rotatably to the boss portion 5a of the intermediate reduction gear 5 and disposed inside the intermediate reduction gear 5. A flat outer-wall-surface 19a is formed on the elastic member 19 as shown in Fig. 16(b) to receive the rotational torque of the intermediate reduction gear 5 when in contact therewith. The elastic member 19 has an opening 19b which receives the bar projection 7d of the cam 7.

The operation (door-unlocking) of this embodiment is described next.

The pinion 4 is driven by the motor 3 and the intermediate reduction gear 5 in mesh with the pinion 4 is rotated. The rotational torque of the intermediate reduction gear 5 is transmitted through the elastic member 19, and the cam 7 rotates in the door-unlocking direction along with the intermediate reduction gear 5 and the elastic member 19.

When the cam 7 abuts the door-unlocking-side torque-receiving-portion 8b, the door-unlocking-side torque-receiving-portion 8b moves along the cam

profile and the actuating lever 8 rotates around the output shaft 15 from the door-locking position to the door-unlocking position. The cam 7 leaves the door-unlocking-side torque-receiving-portion 8b as the actuating lever 8 rotates and further rotates until it abuts the stopper wall 8d of the actuating lever 8. The cam 7 stops when it abuts the stopper wall 8d, however the intermediate reduction gear 5 further rotates while bending the elastic member 19 and stops gradually.

When the motor 3 is deenergized in this state, the intermediate reduction gear 5 is rotated by the spring energy accumulated in the elastic member 19 in the direction opposite the door-unlocking direction. After the energy dissipates from the elastic member, the intermediate reduction gear 5 continues to rotate due to the inertia thereof along with the elastic member 19 and the cam 7 until the cam 7 leaves the stopper wall 8d of the actuating lever 8.

In the second embodiment as described above, the actuating lever 8 which is connected to the door-lock unit DL has the door-unlocking-side torque-receiving-portion 8b which is engaged with the cam 7 and the stopper wall 8d which is formed at the head thereof to move along an arc as described above, the stopper 17 restricts the motion of the actuating lever 8 which is driven by the cam 7, and the elastic member 19 is disposed in the torque transmitting path between the pinion 4 and the lever 8. When the motor 3 is energized, the cam 7 pushes the door-unlocking-side torque-receiving portion 8b thereby to move the actuating lever 8 toward the stopper 17. The cam 7 leaves the arc-shaped motion orbit of the actuating lever 8, thereafter it is driven by the intermediate gear 5 which rotates to bend the elastic member 19 and presses the stopper wall 8d of the actuating lever 8 to deenergize the motor 3. When the motor 3 is deenergized, the cam 7 is driven by the spring force accumulated in the elastic member 19 to separate from the arc-shaped motion orbit of the actuating lever 8. Since the intermediate reduction gear 5 rotates slightly due to the spring force of the elastic member 19 after the motor 3 which is energized to unlock the door is deenergized, the gear noise generated while the intermediate gear is driven by the elastic member 19 can be reduced.

Even if the cam 7 abuts the stopper wall 8d of the actuating lever 8 and its rotation is restricted, the intermediate reduction gear 5 can further rotate and stop gradually while bending the elastic member 19. As a result, the shock applied to the intermediate reduction gear 5 and the pinion 4 generated when the cam stops is reduced so that resinous material may be used to the intermediate reduction gear 5 and pinion 4 as in the first embodiment.

When the motor 3 stops, the cam 7 stops after it leaves the stopper wall 8d of the actuating lever 8. Therefore, a driver can handle the knob 18 without friction force of the actuating lever 8 and the cam 7, and his strength is not required for handling the knob 18. When the motor 3 is energized while the knob 18 is in the locking position, the same effect as in the first embodiment can be expected.

A third embodiment of the present invention is described next.

Fig. 17 is a plan view illustrating an internal structure of a door-lock driving apparatus 1.

In the door-lock driving apparatus 1 of this embodiment, the cam 7 is made of a highly polymerized compound such as elastomer or elastic material such as rubber, and is formed integrally with the elastic member 19 described in regard to the second embodiment.

The cam 7 integrated with the elastic member 19 which is installed in the intermediate reduction gear 5 is illustrated in a cross-sectional view (a) and a plan view (b) of Fig. 18. A perspective view illustrating the cam 7 integrated with the elastic member 19, a perspective view illustrating the intermediate reduction gear 5 and a perspective view illustrating the cam 7 installed in the intermediate reduction gear are respectively (a), (b) and (c) of Fig. 19.

The operation of this embodiment is almost the same as the second embodiment. However, the integration of the cam 7 and the elastic member 19 reduces the number of parts.

A fourth embodiment of the present invention is described next.

Fig. 20 is a plan view illustrating a internal structure of a door-lock driving apparatus.

A reversible small motor 1 is a driving source. A pinion 2 is fixed to a shaft 101 of the small motor 1 and rotates along with the shaft 101. A helical gear (intermediate reduction gear) 3 is carried rotatably by the shaft 4 and engages with the pinion. The helical gear 3 has a flat-plate projection 301 integrally formed therewith to extend in parallel with the shaft 4, and the shaft 4 penetrates the center of the projection 301.

The inner lever (torque transmitting member) 5 is carried rotatably by an output shaft 6. The inner lever 5 is secured solidly to an end of the output shaft 6 and rotates along with the output shaft. Two projecting portions (torque receiving portions) 501 and 502 extending in the radial direction of the output shaft 6 and a spring retaining portion 503 are formed integrally at an end portion of the inner lever 5. A U-shaped groove is formed at an end of the spring-retaining portion 503. The inner lever 5 and the helical gear 3 are disposed so that the projecting portions 501 and 502 of the inner lever 5

face the projection 301 of the helical gear 3. The projection 501 has a door-unlocking-side torque-receiving portion 501a and a stopper wall 501b to be pushed by the projection 301 of the intermediate reduction gear, and the projection 502 has a door-locking-side torque-receiving-portion 502a and a stopper wall 502b pushed by the projection 301 of the intermediate reduction gear. The stopper walls 501b and 502b move in an arc around the shaft 6.

A spring (elastic member) 7 has a U-shaped portion 701 in the center thereof and L-shaped portions 702 and 703 on the opposite sides thereof. The U-shaped portion 701 is fitted into the U-shaped groove so that the spring 7 is fixed to the inner lever 5. The spring 7 is fixed to the inner lever 5 in a manner that the L-shaped portions 702 and 703 extend from the projections 501 and 502 of the inner lever 5.

Cushions (regulating member) 801 and 802 are stoppers to restrict further rotation of the inner lever 5 and are made of elastic material so as to absorb the shock of the collision with the inner lever 5.

An end of the output lever (output portion) 9 is solidly fixed to the other end of the output shaft 6. Therefore, the output lever 9 rotates within the range restricted by the cushions 801 and 802 along with the inner lever 5. The other end of the output lever 9 is connected to the door-lock unit DL. When the inner lever rotates in the direction indicated by an arrow A and abuts the cushion 801 (as shown in Fig. 20), the door-lock unit DL locks the door. On the other hand, when it rotates in the direction indicated by an arrow B and abuts the cushion 802, the door-lock unit DL unlocks the door. The relationship between the rotating direction and the locking/unlocking condition may be reversed.

All the parts and components except for the output lever 9 are accommodated in a case 10 and the open end thereof is covered by a cover 11.

The operation of this embodiment is described next. The main portion of this embodiment is the helical gear 3, the inner lever 5 and the spring 7 and therefore the description about these components are given next with reference to Fig. 22 through Fig. 28.

Fig. 22 through 28 illustrate the helical gear 3, the inner lever 5 the spring 7 and cushions 801 and 802 which are illustrated in Fig. 20.

Fig. 22 illustrates the same state as in Fig. 20 in which the inner lever 5 drives the door-lock unit DL to the door-locking state through the output lever 9. When the small motor 1 is energized and rotates the helical gear 3 in the direction indicated by an arrow C (door-unlocking direction) from the above state, an end portion 302 of the projection 301 abuts the projection 501 of the inner lever 5, thereby to transmit the rotating torque to the inner lever.

When the helical gear 3 further rotates, as shown in Fig. 24, the rotating torque is transmitted to the projection 501. Thereafter, as shown in Fig. 25, the rotating torque is not transmitted any longer. Before then ,the inner lever 5 is driven by the door-lock unit DL, which is under operation of the door-unlocking and under motion of the inertia of the helical gear, to rotate in the direction to the cushion 802. Thus, the inner lever 5 further rotates until it abuts the cushion 802 even after the projection 301 of the helical gear 3 leaves the inner lever 5 (as indicated by L).

The other end portion 303 of the projection 301 of the helical gear 3 abuts one of the L-shaped portion 703 and bends the spring 7 to the direction indicated by an arrow C as shown in Fig. 26 against the spring force. When the projection 301 abuts the other projection 502 of the inner lever 5, the rotation is restricted as shown in Fig. 27. The spring 7 has accumulated energy to drive the helical gear by the other end portion 303 of the projection 301 in the direction opposite the arrow C until this state. As a result, when the small motor 1 is deenergized, the helical gear 3 is rotated due to the repulsion force of the spring 7 in the direction opposite the arrow C to a position where it does not interfere with the inner lever 5 and it stops in the door-unlocking state. Since the inner lever 5 is free from any interference, only small power is necessary to handle the output lever 9 from the outside for the door-locking.

In the apparatus according to the embodiment as described above, the inner lever 5, which is connected to the door-lock unit DL, has the door-locking-side torque-receiving portion 501 which the projecting portion 301 of the intermediate reduction gear 501a 7 abuts and the stopper wall 502b which is formed at the head portion moving in an arc, the cushion 802 restricts further movement of the inner lever 5 against the rotating torque exerted by the projecting portion 301, and the spring 7 is disposed in the path of the torque transmission. Therefore, when the motor 3 is energized, the projecting portion 301 of the intermediate reduction gear presses on the door-unlocking-side torque-receiving-portion 501a to move the inner lever 5 toward the cushion 802 and leaves the generally arc-shaped operation orbit of the inner lever 5. The projecting portion 301 subsequently pushes the cushion 802 while compressing the spring 703 thereby to deenergize the motor 1. When the projecting portion 301 of the intermediate reduction gear leaves the arc-shaped operation orbit of the inner lever 5 again due to the elastic energy accumulated in the L-shaped potion 703 of the spring 7, the motor 1 is energized to carry out the door-unlocking. When the motor 1 is

deenergized thereafter, the intermediate reduction gear 3 is slightly moved due to the spring force of the L-shaped -portion 703 of the spring 7, accordingly the gear noise is significantly reduced. The door-locking is also carried out by energizing the motor 1. In this case, since the intermediate reduction gear 3 is slightly moved due to the spring force of the L-shaped projecting portion 702 of the spring 7 after the motor 1 is deenergized as in the door-unlocking operation, the gear noise is reduced significantly.

Since only two components, the inner lever 5 and the spring 7, function as a clutch mechanism, the production cost may be reduced.

Fifth and sixth embodiments are described next with reference to Fig. 29 and Fig. 30.

These embodiments omit the cushions 801 and 802 in the above described embodiment and therefore the production cost may be reduced.

In the fifth embodiment illustrated in Fig. 29, the spring 7 has respective bends at the opposite ends of L-shaped portions 702 and 703, which abut the inner walls of the case 10 and function as the cushions 801 and 802, respectively.

The sixth embodiment has two rubber cushions 12 which are fixed to the inner lever 5 instead of the spring 7. They abut the inner walls of the case 10 and function as the cushion 801 and 802 in the same manner as shown in Fig. 29.

The cushions 12 illustrated in Fig. 30 may be combined together. When the rubber cushions 12 are employed solely for replacement of the spring 7, the cushions 801 and 802 may be left, naturally.

INDUSTRIAL APPLICABILITY

As mentioned above, in the door-lock driving apparatus according to the present invention, after the motor carries out the door-locking or door-unlocking and it is deenergized, the elastic member can reduce the shock which is otherwise generated when the intermediate reduction gear operates.

Claims

1. A door-lock driving apparatus comprising:

   a motor rotating when energized;

   a rotating member rotated freely by the motor and a torque transmitting member for transmitting the rotating torque of the rotating member;

   an actuating member, connected to a door-lock unit for carrying out door-locking and door-unlocking, for actuating said door-locking unit when driven by said torque transmitting member to move to a door-locking direction or a door-unlocking direction, said actuating member having a first member to be pushed by said torque transmitting member and a second member formed on an end portion of said actuating member which moves in an arc;

   a restricting member for restricting motion of said actuating member against rotating torque exerted by said torque transmitting member; and

   an elastic member disposed between said rotating member and said actuating member; wherein

   when said motor is energized, said torque transmitting member pushes said first member of said actuating member and drives said actuating member against said restricting member, separates from an arc-shaped motion orbit of said actuating member, subsequently pushes said second member while bending said elastic member to deenergize said motor, and separates again from said arc-shaped motion orbit of said actuating member due to spring force accumulated in said elastic member.

2. A door-lock driving apparatus claimed in claim 1 further comprising a manually operated member connected to said door-lock unit or said actuating member, wherein

   when said manually operated member is held in a door-locking position, said elastic member bends as it receives rotating torque of said rotating member moving to said actuating member which is retained by said manually operated member and relieves shock applied to said rotating member, and when said motor is deenergized, said torque transmitting member stops after said torque transmitting member separates from said actuating member due to spring force accumulated in said elastic member.

3. A door-lock driving apparatus claimed in claim 1 or claim 2, wherein

   said rotating member comprises a pinion driven by said motor and an intermediate reduction gear;

   said torque transmitting member is disposed to be rotatable relative to said intermediate reduction gear around a central axis of said intermediate reduction gear; and

   said elastic member comprises a coil spring held by said intermediate reduction gear at its one end and held by said torque transmitting member at the other end.

4. A door-lock driving apparatus claimed in claim 1 or claim 2, wherein

   said rotating member comprises a pinion

driven by said motor and an intermediate reduction gear;

said torque transmitting member is disposed to be rotatable relative to said intermediate reduction gear around a central axis of said intermediate reduction gear; and

said elastic member is made of highly polymerized compound such as elastomer or elastic material such as rubber and is disposed between said intermediate reduction gear and said torque transmitting member.

5. A door-lock driving apparatus claimed in claim 4, wherein said torque transmitting member comprises an integral elastic member made of highly polymerized compound such as elastomer or elastic material such as rubber.

6. A door-lock driving apparatus comprising:

a pinion driven by a motor;

an intermediate reduction gear which is in engagement with said pinion and is driven by said pinion;

a projection rotating with said intermediate reduction gear;

a torque transmitting member having a torque transmitting portion at one end and a portion at the other end which is fixed to said torque transmitting portion and connected to an output member for carrying out door-locking operation;

a restricting member for restricting motion of said torque transmitting member against said transmitting torque; and

an elastic member, disposed between said projection of said intermediate reduction gear and said torque transmitting portion of said torque transmitting member, for generating driving force to separate said projection from said torque transmitting means by bending.

FIG. 1

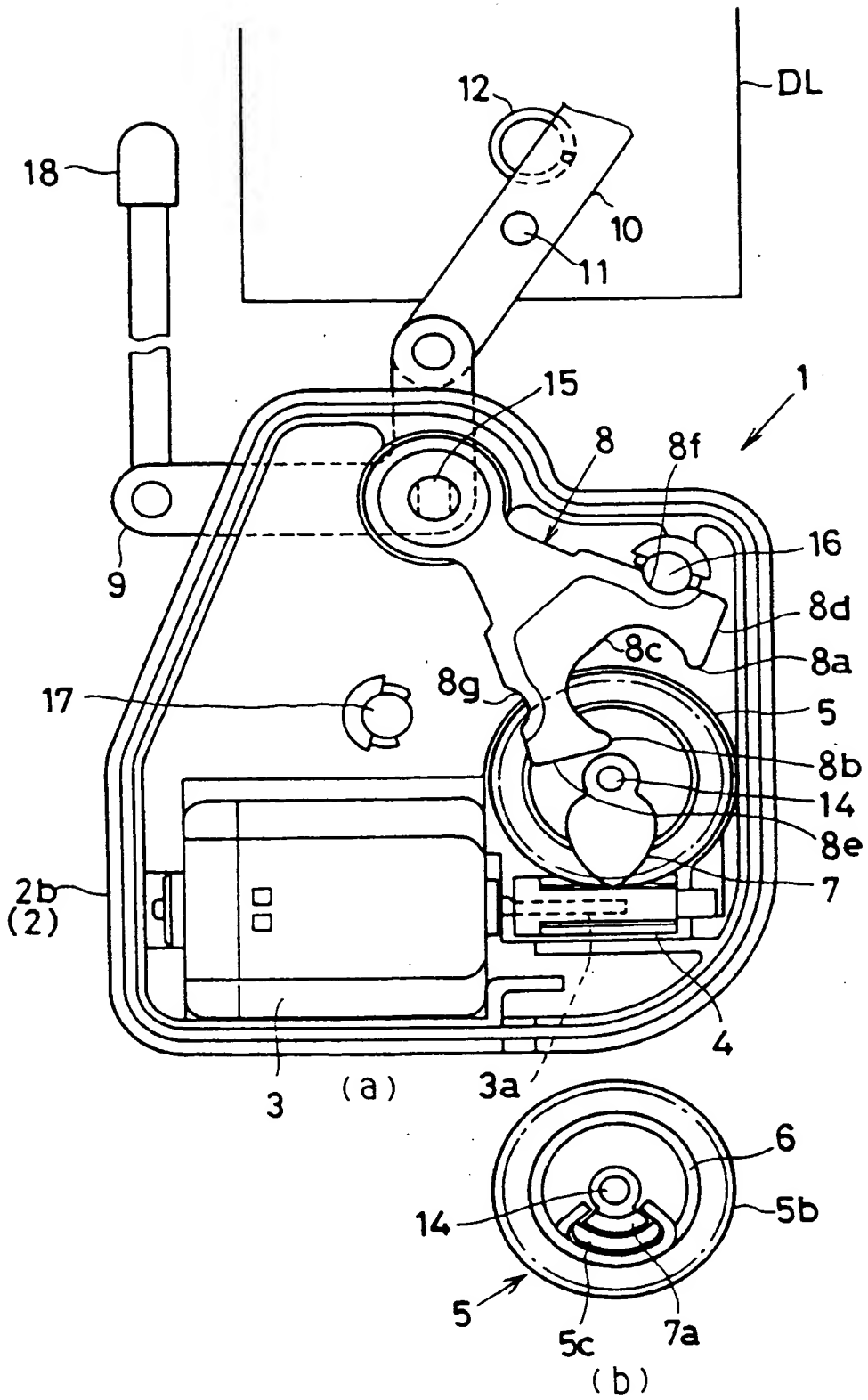

DL
12
18
10
11
15
1
8
8f
16
9
8d
8c
8a
17
8g
5
8b
14
8e
7
2b
(2)
4
3
(a)
3a
6
14
5b
5
5c
7a
(b)

FIG. 2

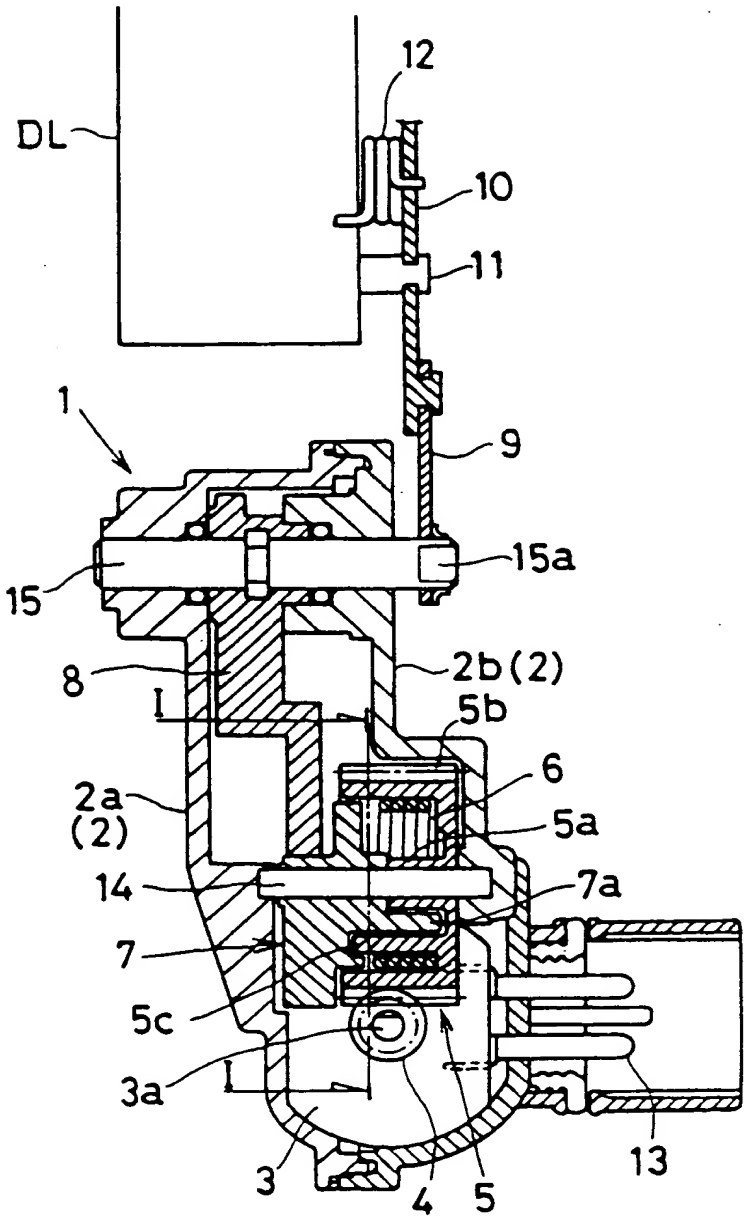


FIG. 3

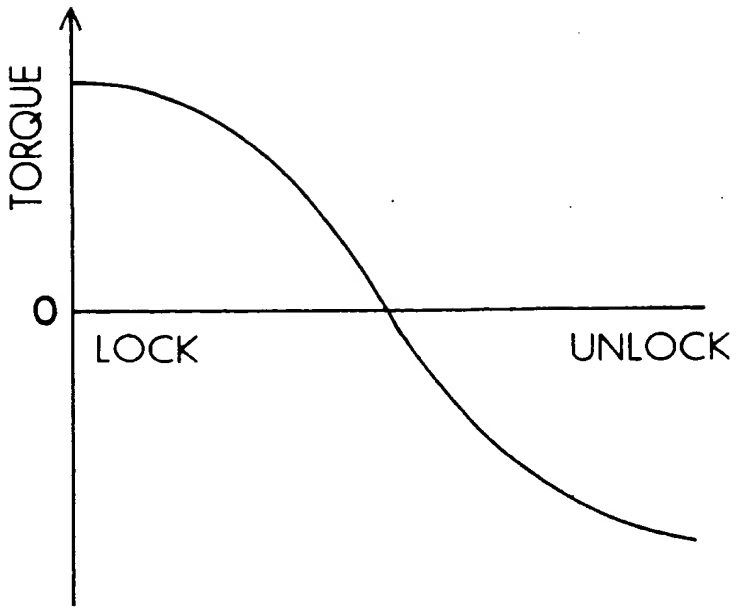


FIG. 4

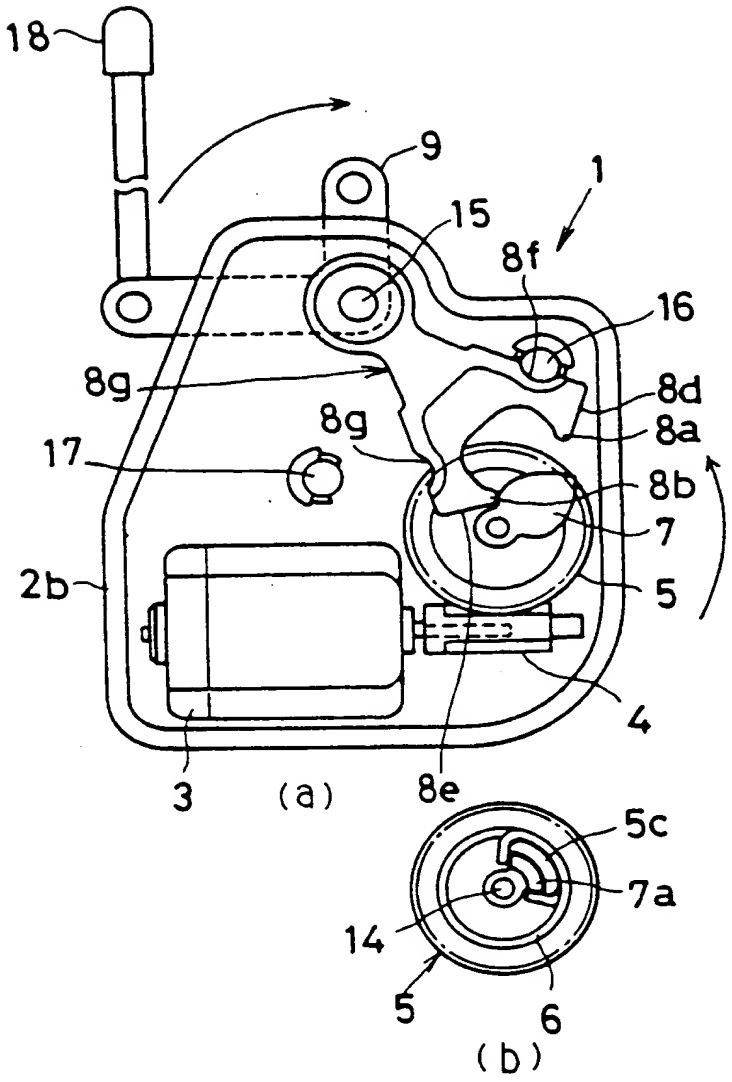


FIG. 5

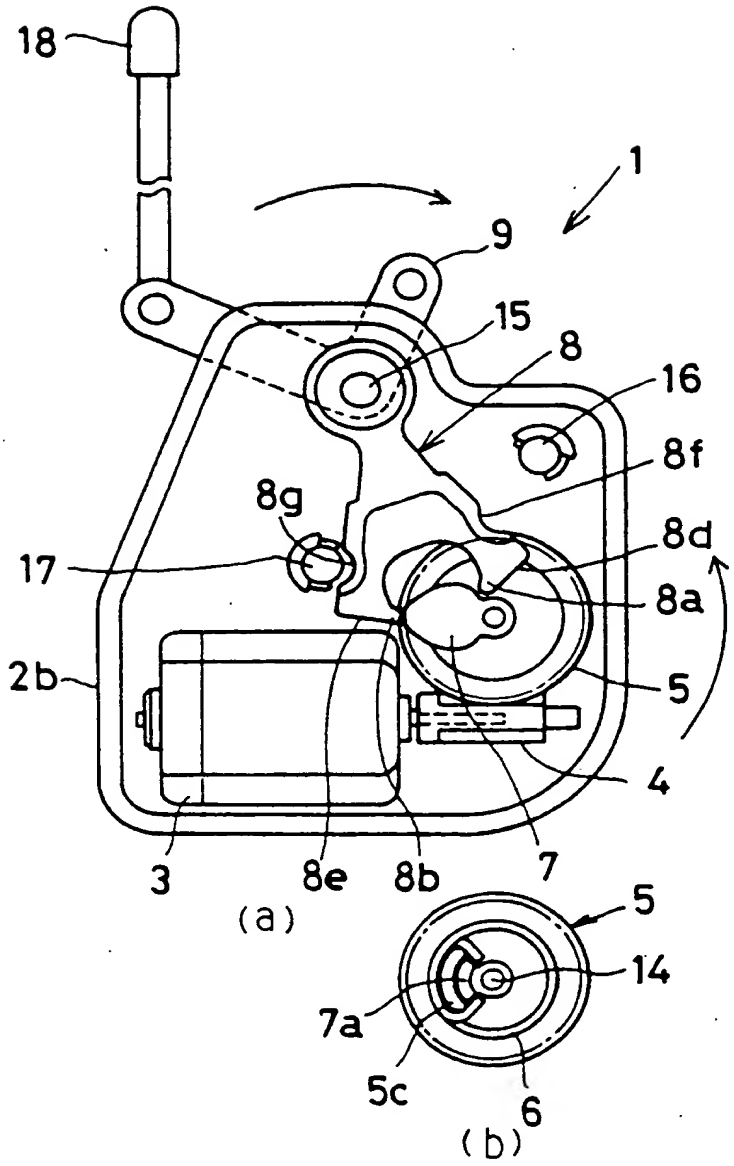


FIG. 6

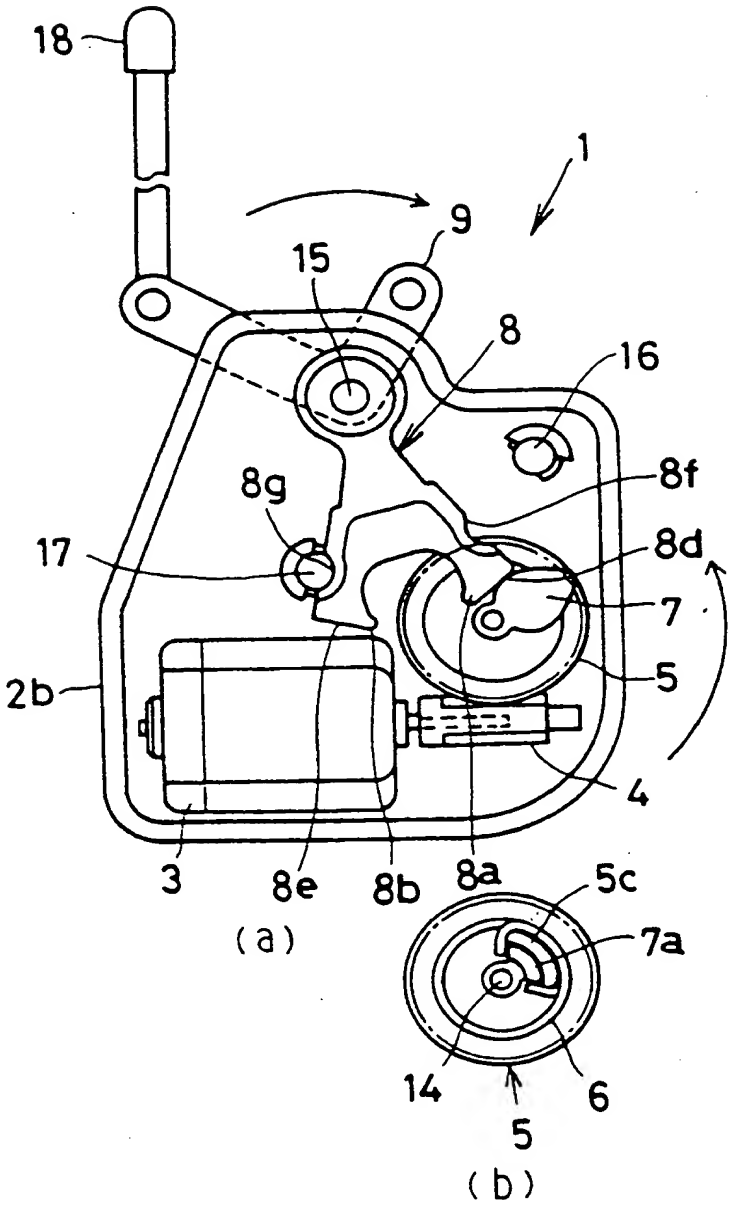


FIG. 7

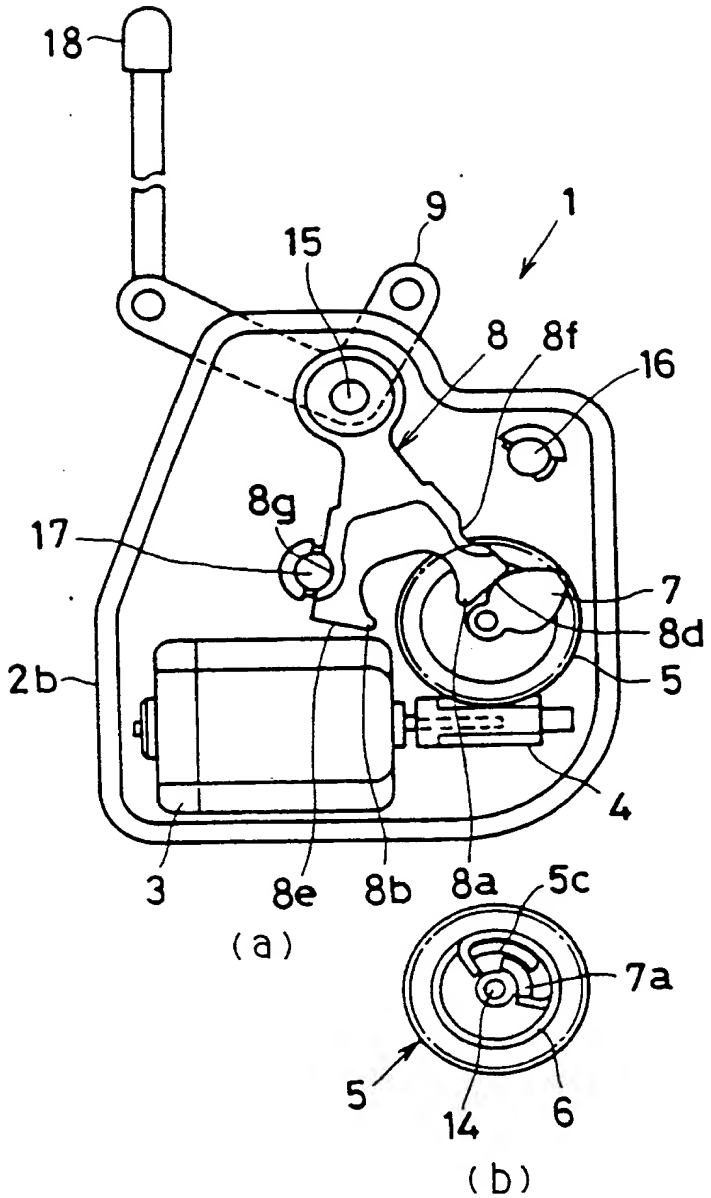


FIG. 8

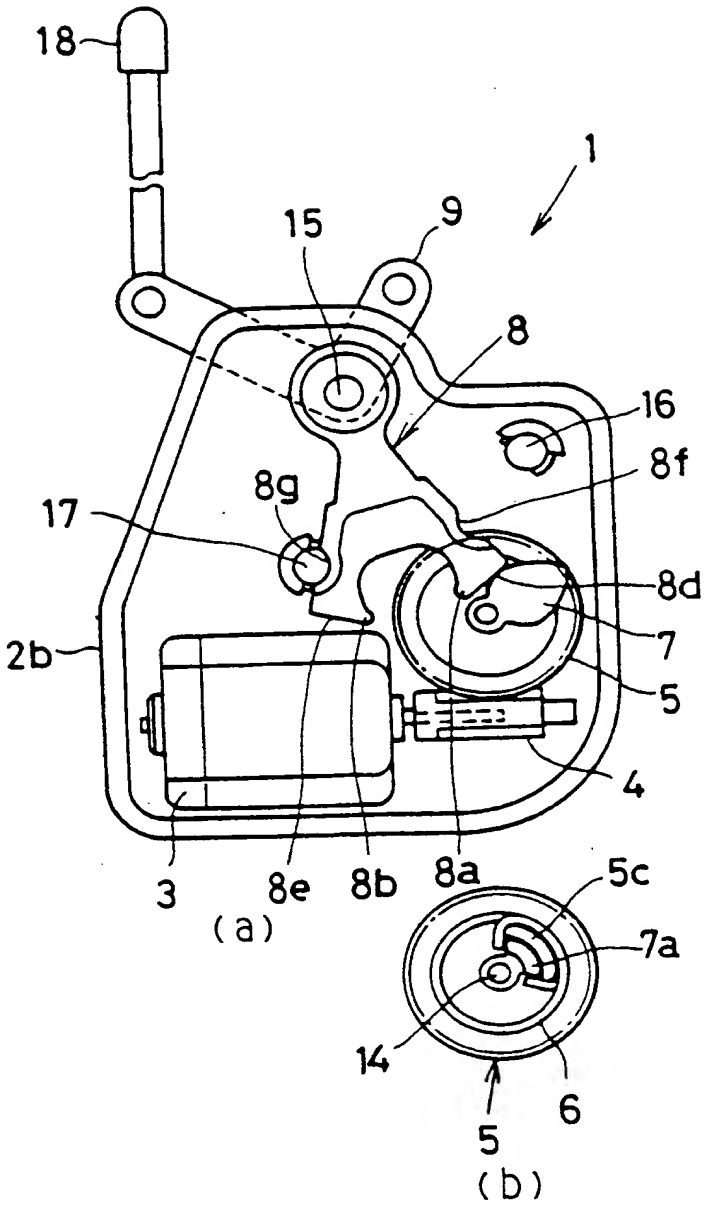


FIG. 9

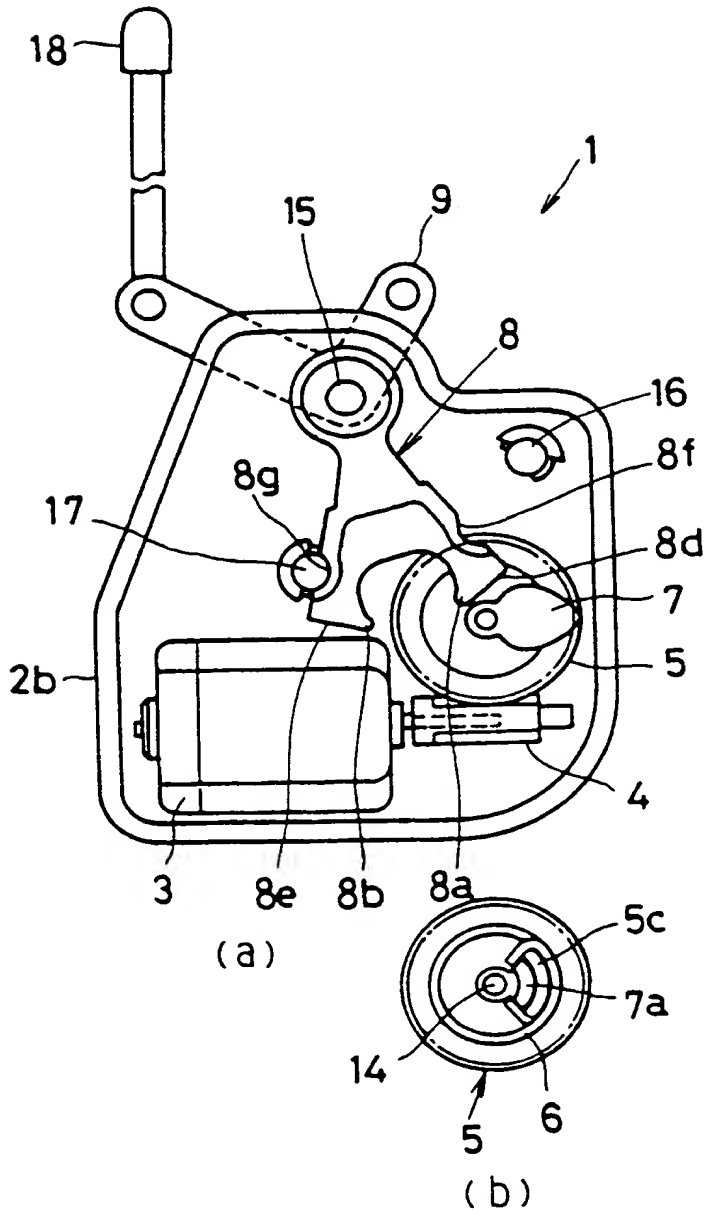


FIG. 10

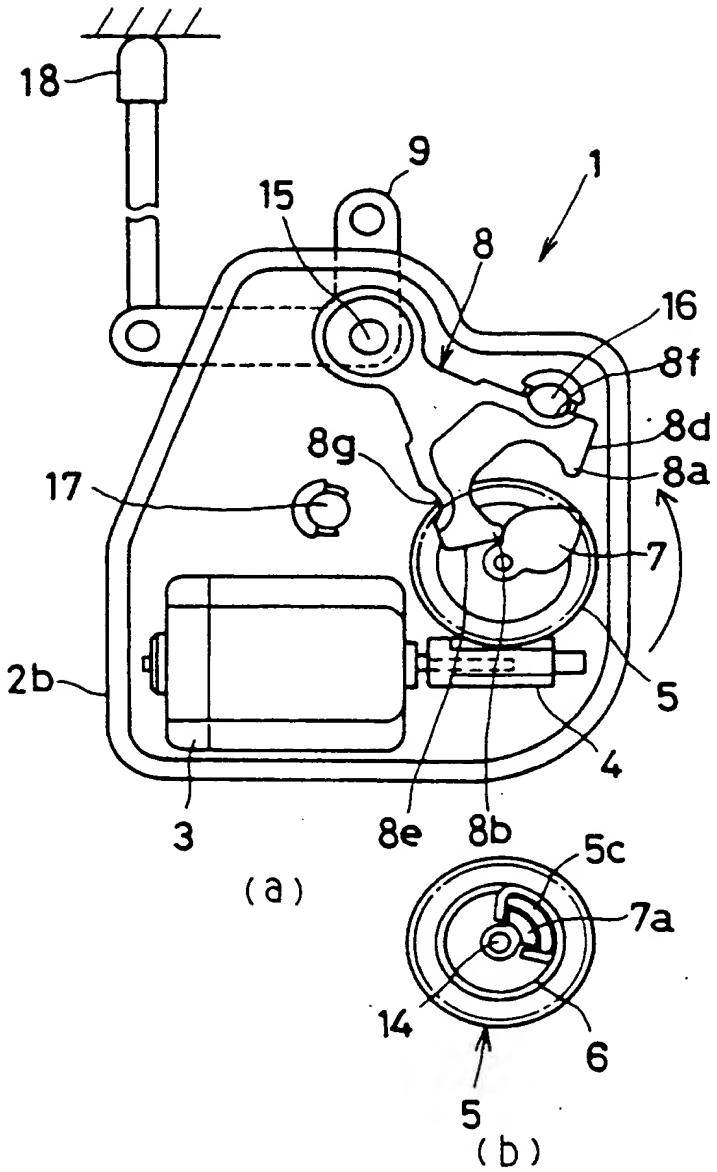


FIG. 11

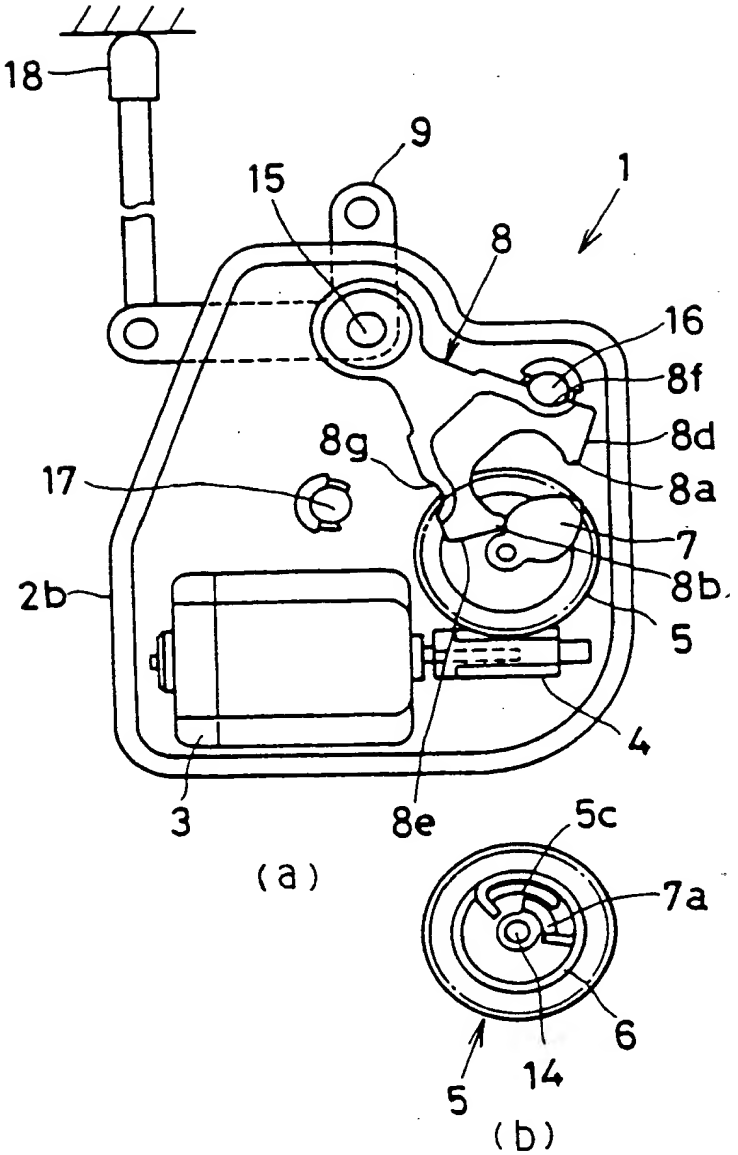


FIG. 12

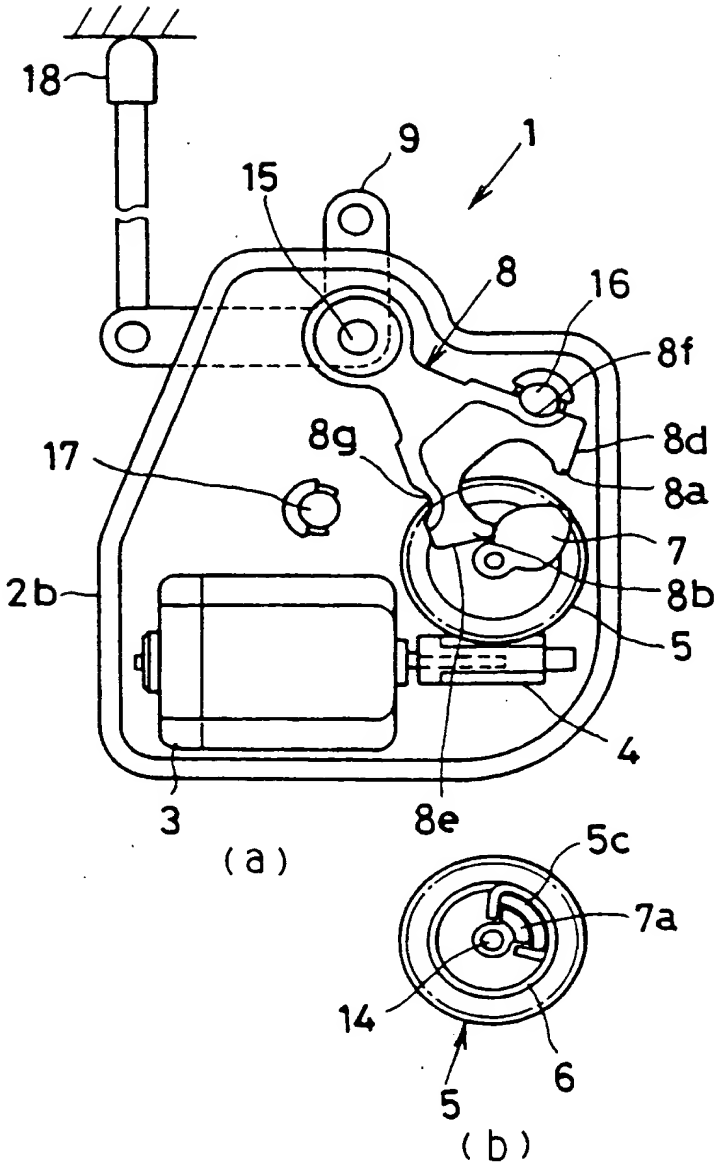


FIG. 13

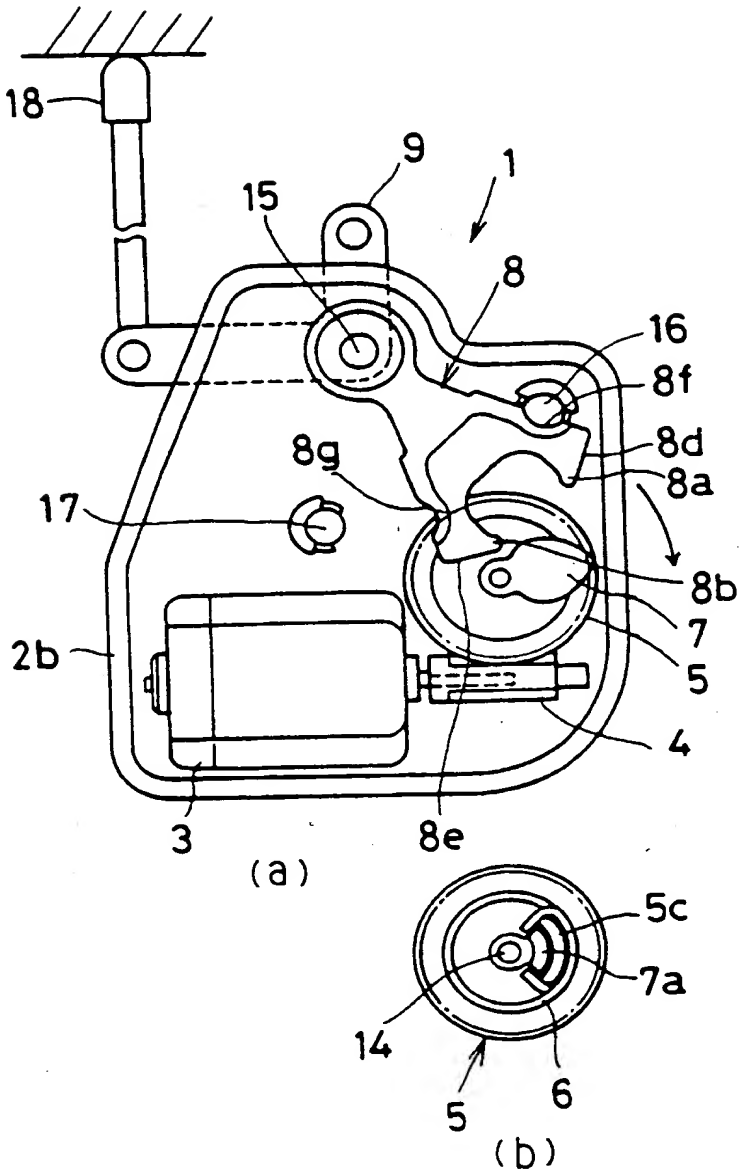


FIG. 14

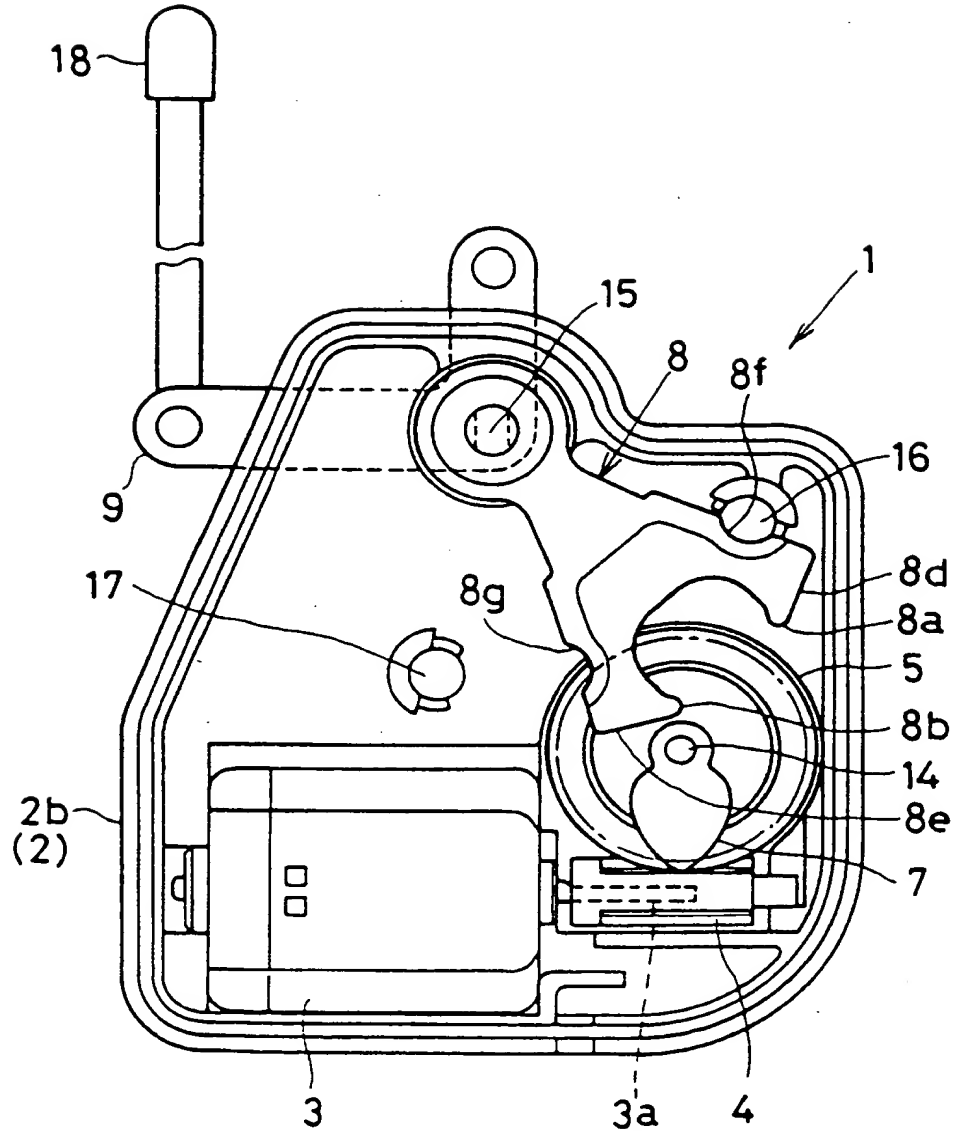


FIG. 15

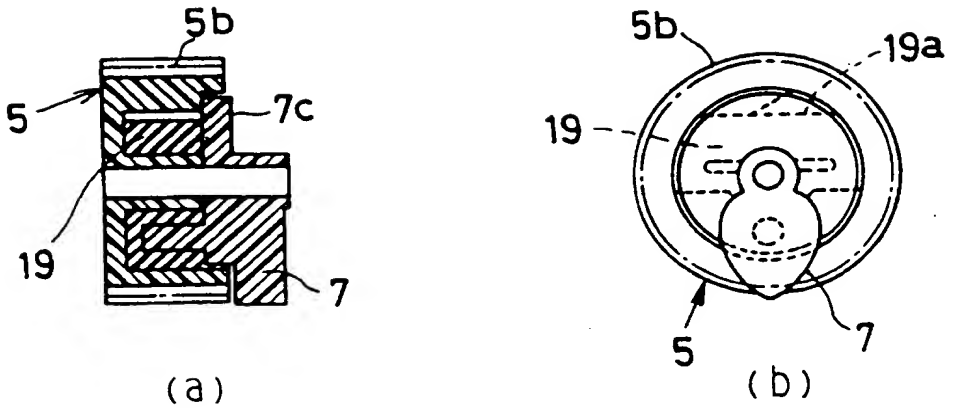


FIG. 16

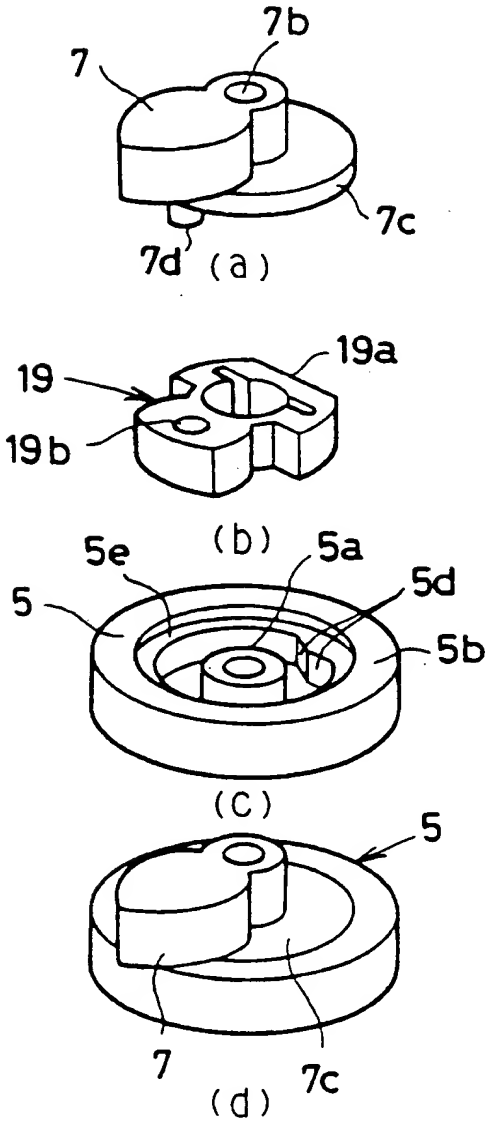


FIG. 17

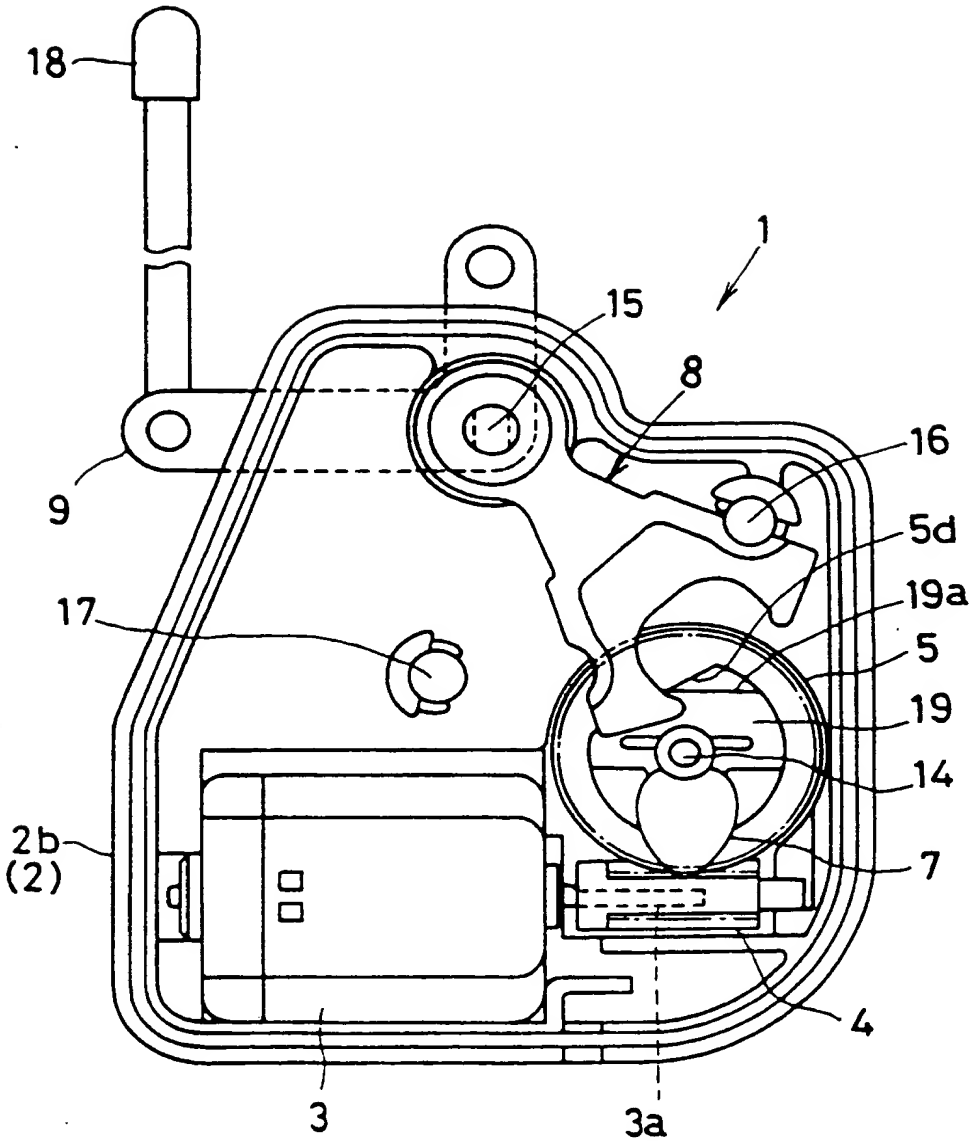


FIG. 18

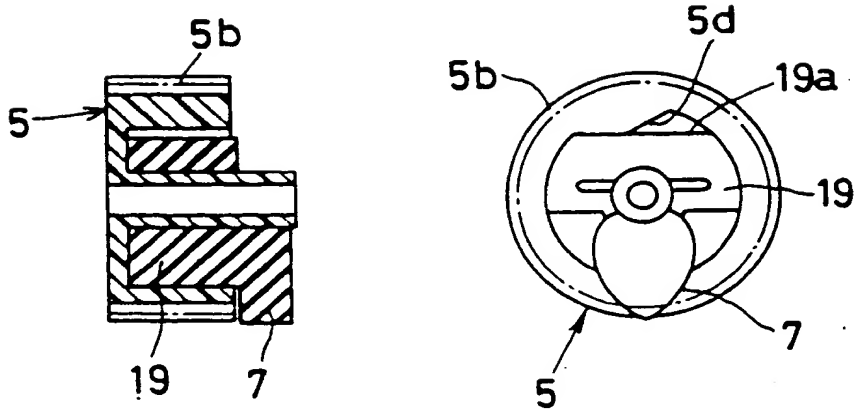


FIG. 19

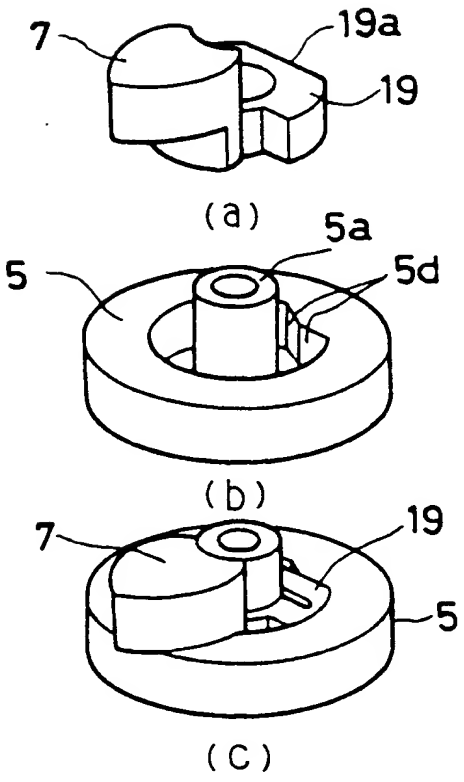


FIG. 20

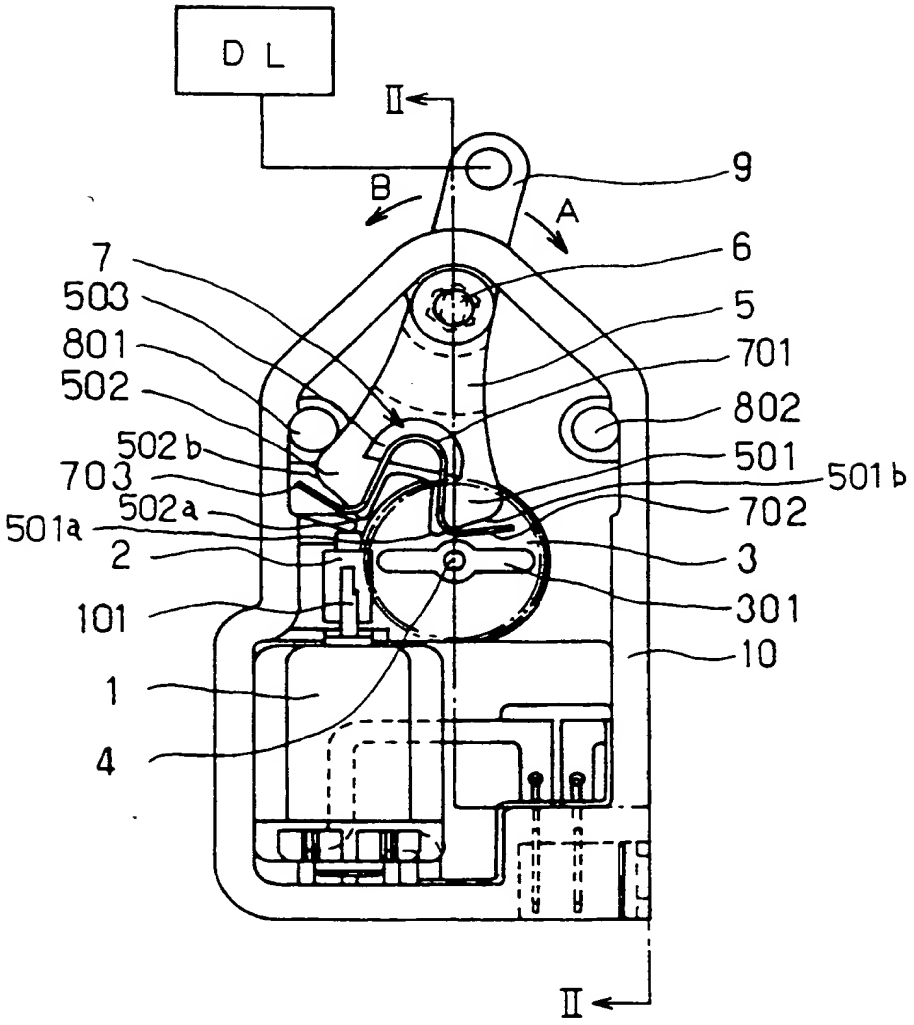

D L
II
9
B
A
7
503
801
502
502b
703
502a
501a
2
101
1
4
6
5
701
802
501
501b
702
3
301
10
II

FIG. 21

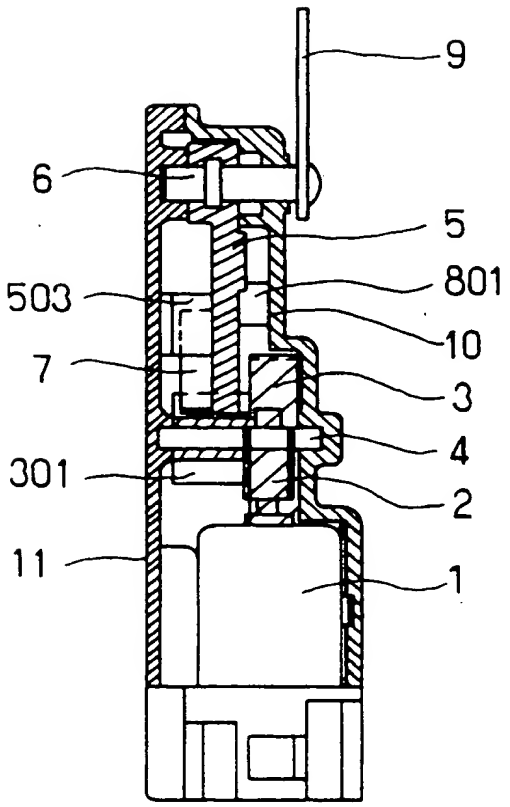


FIG. 22

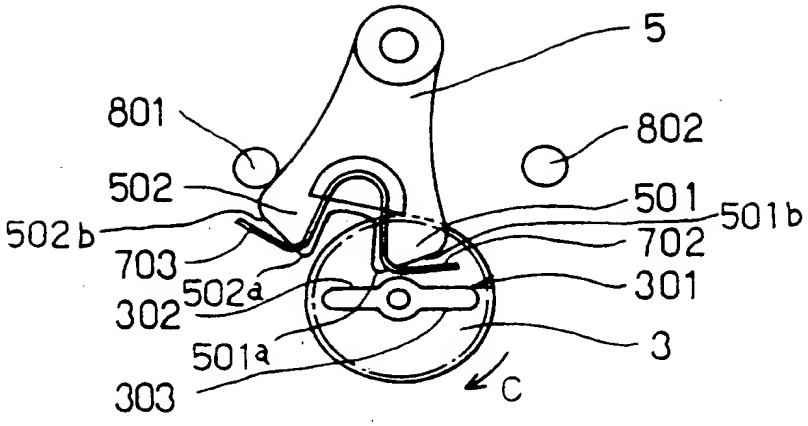


FIG. 23

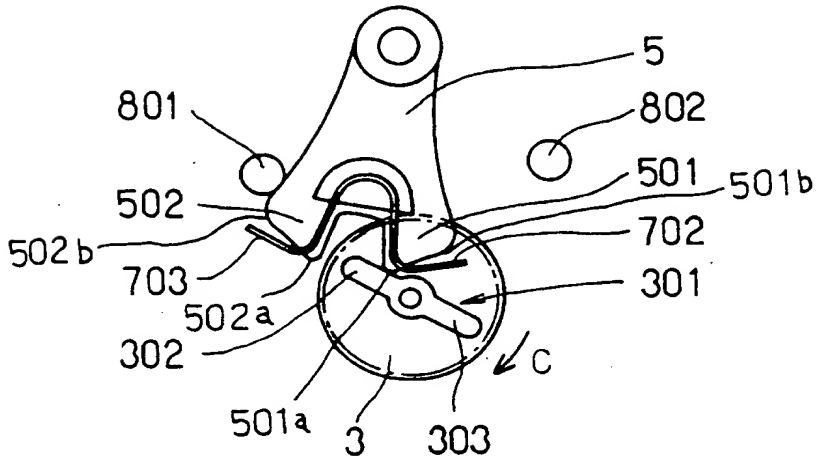

5
801
802
501
501b
502
502b
702
703
301
502a
302
C
501a
3
303

FIG. 24

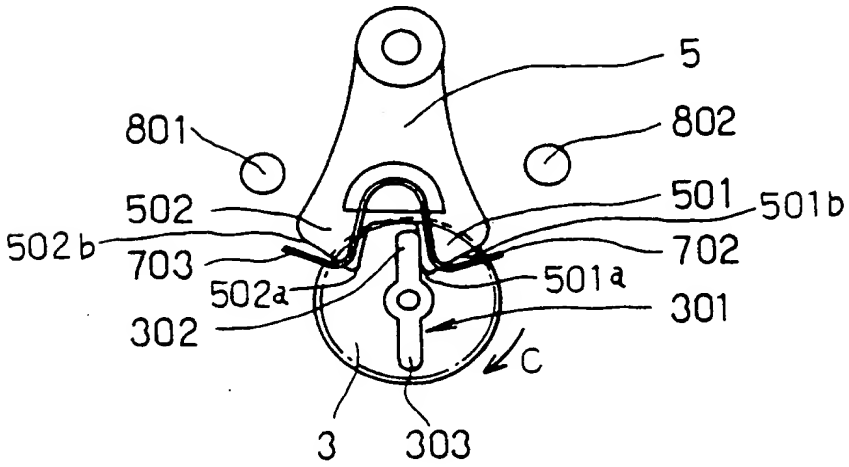

5
801
802
502
501
501b
502b
703
702
502a
501a
302
301
C
3
303

FIG. 25

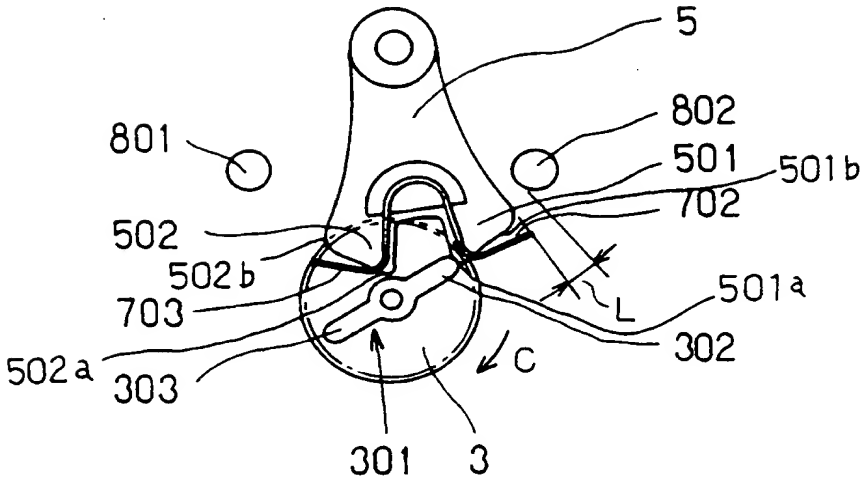

5
801
802
501
501b
702
502
502b
703
L
501a
502a
303
302
C
301
3

FIG. 26

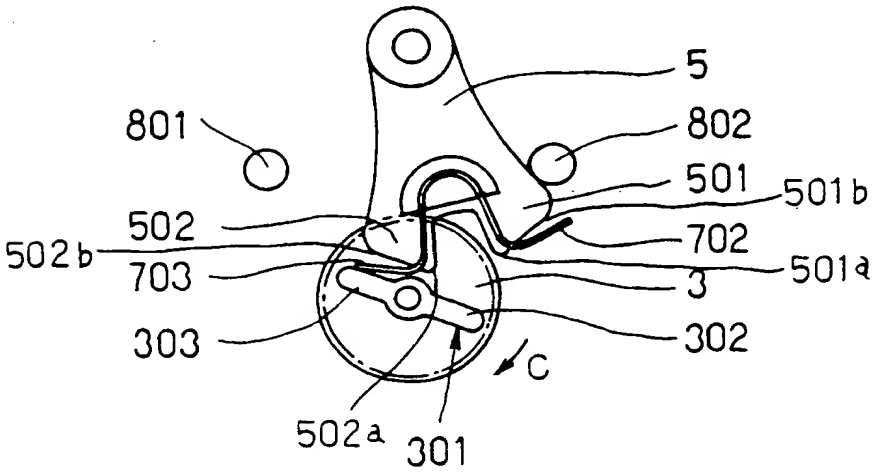

5
801
802
501
501b
502
502b
703
702
501a
3
303
302
C
502a
301

FIG. 27

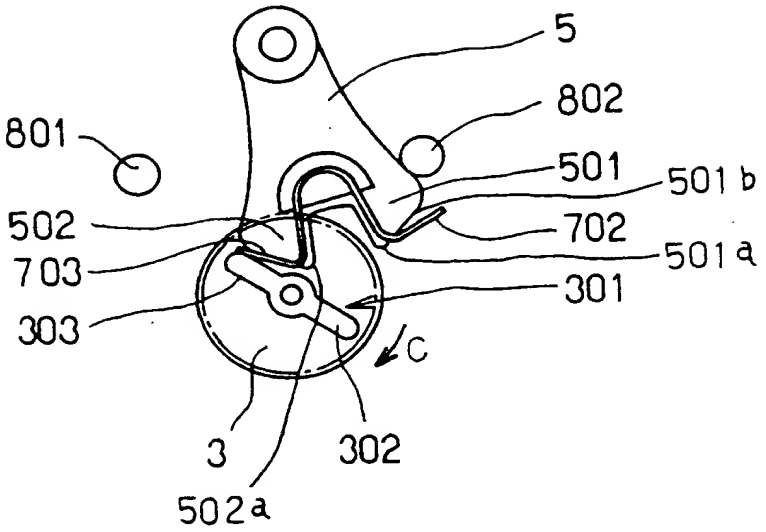

5
802
801
501
501b
502
702
703
501a
301
303
C
3
302
502a

FIG. 28

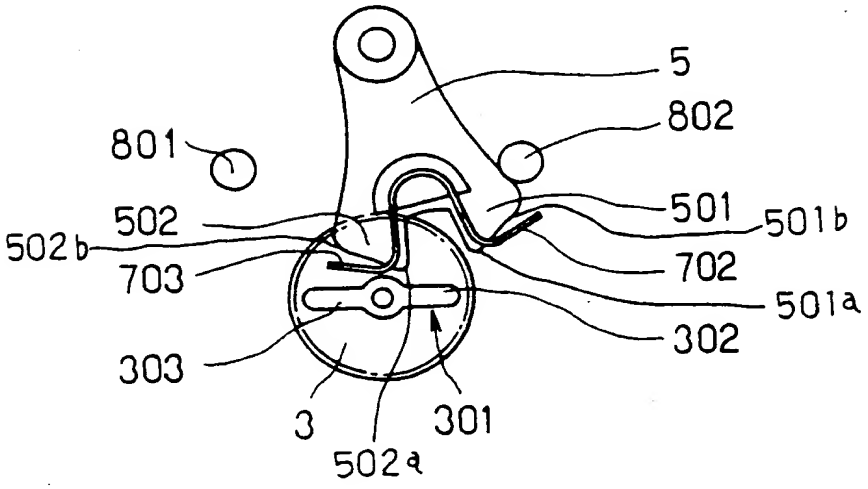

5
802
801
501
502
501b
502b
702
703
501a
302
303
3
301
502a

FIG. 29

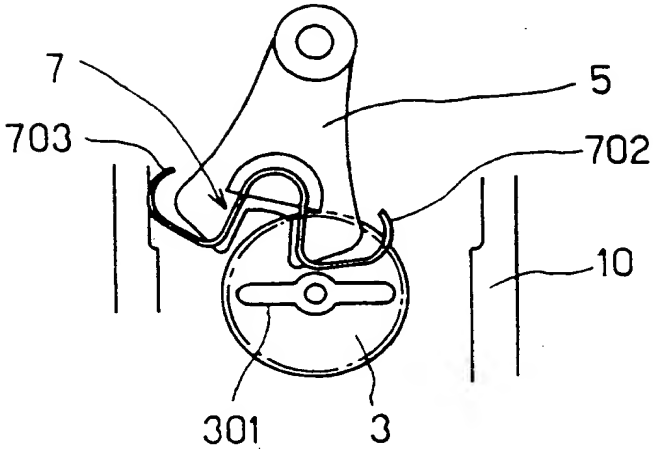
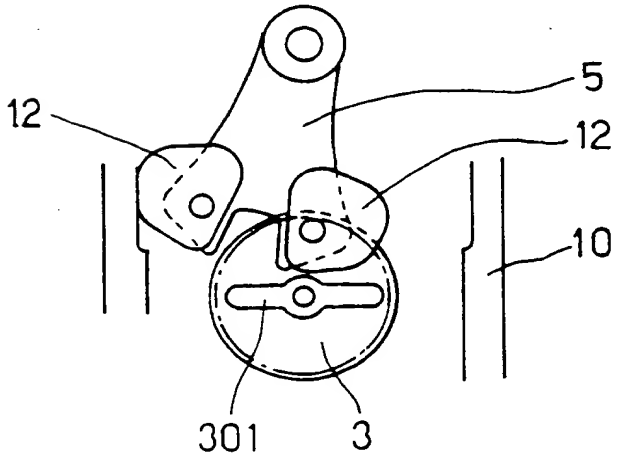


FIG. 30



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP94/02030

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl^6 E05B65/20

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Int. Cl^6 E05B65/20

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho 1926 - 1994
Kokai Jitsuyo Shinan Koho 1971 - 1994

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP, A, 1-250582 (Aishin Seiki Co., Ltd.), October 5, 1989 (05. 10. 89), Line 12, lower right column, page 4 to line 4, lower right column, page 5 (Family: none)	1-6
A	JP, B2, 62-26383 (Nissan Motor Co., Ltd., Jidosha Denki Kogyo K.K.), June 9, 1987 (09. 06. 87), Line 30, column 7 to line 12, column 11, Fig. 12 & EP, A2, 64602 & US, A, 4,502,718	1-6

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
January 24, 1995 (24. 01. 95)	February 14, 1995 (14. 02. 95)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)